Producing and Maintaining Culturally Adaptive Teaching and Learning of Science in Urban Schools

Kenneth Tobin · Rey Llena

Science achievement in urban schools is related to social class (Morais, Fontinhas, and Neves 1992), especially in high poverty regions in which ethnic minorities attend neighborhood schools (e.g., Tobin, Elmesky, and Seiler 2005). Unfortunately, solutions to the problems have been characterized in terms of reducing achievement gaps, framing the problems and potential solutions in terms of deficit perspectives that embrace meritocracy and, especially holding individuals accountable for their own achievement and, in the case of teachers, for their students' achievement. Usually ignored are the cultural resources, which are the very building blocks on which science achievement can grow. In our ongoing research we have searched for the capital used by youth belonging to social categories that appear to be disadvantaged in many fields of their lifeworlds. However, they succeed in many ways and we take care not to overlook the resources they deploy in attaining their goals. Accordingly, our project has sought to identify the culture that is a foundation for success in out-of-school fields and explore ways in which similar culture might support learning in schools (Tobin 2007a). Our research shows how social class, often associated with poverty, affords the production of culture (i.e., science learning). However, social categories such as race, ethnicity and sex also serve as mediators of cultural production and it can be challenging for teachers who belong to different social categories to be effective teachers of students who are "culturally other." For example, later in the chapter we discuss the problems experienced by an immigrant teacher from Egypt, who struggled to teach ethnically diverse youth—none emigrating from Egypt. In order to teach successfully a teacher has to know the field in which culture is to be enacted and that implies having a sense of the game that allows her to anticipate what is to come and act appropriately just in time. Being at home with the culture of others usually necessitates, and probably always necessitates, extensive experience with that culture, learning about it by being with actors as they participate in the activity of the field. Implied is cultural adaptivity where teachers know the culture of their students and can adapt to it and students can successfully adapt to one another's culture and their teacher's culture.

> Culture is associated with a field and consists of the participants' practices and other resources that structure the field. Culture is theorized as a dialectical relationship between practices and associated schema. Hence, within a field culture is dynamic, reflecting the structural flux in which all enaction is immersed. Culture occurs in fields in characteristic ways that can be thought of as patterns that have thin coherence, always accompanied by contradictions (Sewell 1999). As it is enacted, culture becomes a resource, which is a structure, which can support further cultural production either through the agency of participants or passivity (see Roth 2007).

In a program of research that has extended for more than a decade we have

Kenneth Tobin and Reynaldo Llena
The Graduate Center of CUNY
Urban Education Program
Email: ktobin@gc.cuny.edu

developed an approach that recognizes the worth of the cultural resources of others and assumes that effective collaborations can be built around differences and support the learning of all participants in a field. In this chapter we describe what we have learned about teaching and learning science in urban schools and present some illustrative examples of impressive improvements in the quality of learning environments and outcomes such as coming to school, staying engaged, and collaborating with the teacher and peers to focus on the learning of science.

Unless noted below, the text reflects a collective voice of the authors. Personal pronouns such as I and me denote Ken's voice and grey shaded text denotes Rey's voice. Usually Rey's voice interrupts the text and is not intended to extend ideas being developed either using my voice or a collective voice. Occasionally I use a textbox to provide a voice-over commentary that is a reflective analysis that occurred after the initial writing of the chapter. My voice-over contributions also are intended to disrupt the flow of the manuscript.

Researching science education in urban schools

When I was Director of Teacher Education at the University of Pennsylvania the principal of a nearby school suggested coteaching as an experiment designed to allow prospective science teachers to collaborate to teach biology to urban high school youth. The problem he sought to resolve was that the students were so unsettled and seemingly unmanageable that the regular classroom teacher was reluctant to surrender the class to a novice. The principal had other ideas though. He felt that the energy and expertise that prospective teachers would bring to the classroom would be recognized by youth as highly desirable and they would respond accordingly. Since, in this case, all the prospective teachers already had a degree in science it was possible for them to obtain emergency certification and thereby to teach together without the presence of a regular certified teacher. Hence, the initial idea was to capitalize on the strengths of the prospective science teachers to enact engaging and challenging curricula that would benefit urban youth.

I agreed to carefully research what happened and ascertain whether or not coteaching was an approach we would use throughout the program. The results from the first test were encouraging and during the next semester the entire cohort of prospective high school teachers was involved in coteaching, an approach that I continued to research with colleagues for the six years I was at the University of Pennsylvania.

At the same time the coteaching experiment was initiated all prospective teachers were collaborating with two youth selected from each class they taught to coach them on "how to better teach kids like me." When coteaching emerged as a way of teaching urban youth the conversations between the youth and the coteachers had more participants (since there were now two to three teachers) and a greater sense of collective was evident. After a year or so of coteaching we formulated a rule structure for what was to happen during these discussions. Initially the conversations were to be about praxis, that is, the knowledge enacted in the classroom by all participants. The focus for discussion could be on things that were good and should be retained and/or on aspects of the class that should be improved. Since the participants in the conversations should have had a shared experience we soon realized that individuals could not be held responsible for either good or bad things. The responsibility for high quality learning environments was shared among the collective of all participants (and by many of those who were not involved in the conversation—such as policy makers). Hence, at the end of each conversation it was desirable that the collective could reach agreement on what they had decided to do in the next class meeting. Usually the outcomes were requirements to make changes so as to improve the quality of teaching and learning. Because all participants needed to concur with the outcomes we decided to call the field cogenerative dialogue (hereafter cogen). That is, outcomes were to be cogenerated during the dialogue with the purpose of improving the quality of teaching and learning.

As our research progressed it was apparent that the dialogue that produced agreed to changes to be enacted in the classroom also afforded the production of various forms of culture. We regarded cogens as seedbeds for the growth of new culture. In essence, the cogen field was a place where students and teachers could learn to interact successfully and, in so doing, produce a range of culture that would support successful interactions in similar circumstances in the future. When similar structures were present we would expect much the same culture to be enacted, irrespective of the field. Hence, cogens were regarded as a place for producing new culture, expanding the agency of participants, and changing identities. This was a new way to think about cogens—as places for producing culture, including emotions. When I left Philadelphia my new research in New York City (NYC) still involved cogens, but no longer involved coteaching as a primary focus. A new program of research, which is now in its sixth year, involved a set of teacher researchers using cogens in science and mathematics classes in Manhattan, the Bronx, Brooklyn, Queens, and Long Island. In this chapter the primary focus is on research undertaken at New York High (NYH), a small school in the Bronx.

About this research

The research in this chapter is framed within a sociocultural framework that regards knowing as cultural enactment or production—always occurring in fields that are structured. Structures, which are resources to support production, can be transformed by the agency of participants and for this reason fields are dynamic as the structural flux that supports activity is constantly changing. Cultural reproduction also occurs because of resonance, which affords continuous cultural production to occur without the actor having full control, that is action occurs that is non-agentic—theorized here as a dialectical relationship between agency and passivity (i.e., agency|passivity). This relationship is salient to the research we have engaged on cogens because not only is culture produced in cogens due to the agency of the participants, but also because of passivity as participants in a cogen learn from one another by being with one another in close proximity. Hence, as we do research on the teaching and learning of science and uses of cogens to improve the quality of learning environments we ensure that we seek to understand cultural production in terms of agency and passivity (Tobin and Roth 2006).

When I moved to the Graduate Center in 2003 I expanded to NYC a research project that was initiated in Philadelphia. The research was multi site, each site being coordinated by a teacher researcher collaborating with student researchers. Four teacher researchers began the project in NYC, one site being at NYH, in the Bronx. The first teacher researcher at NYH was Christopher Emdin (Emdin 2007), who is referred to throughout this chapter as Chris. The second teacher researcher, Rey, joined NYH a year later and became a teacher researcher during his first year at the school. The research of another of the original four teacher researchers, Ashraf Shady (hereafter referred to as Ashraf), is cited in this chapter (Shady 2008). In the ongoing research teacher researchers continue to join the research squads that meet twice each week in NYC and others leave, such as Chris, to form their own squads. At the present time the ongoing research on cogens, situated at the Graduate Center, involves 16 teacher researchers and foci on science, mathematics and technology in K-12 schools, teacher education programs, college (undergraduate through doctoral), and museums. In addition, once a month a larger group of researchers who employ a sociocultural methodology in their research meet in NYC as part of the Urban Science Education Research Network. Through the Network, peer debriefing and collaboration are central to the research project that is the focus of this chapter.

The research employs methods that cohere with a bricolage of sociocultural theory that draws on, but is not limited to, cultural sociology (e.g., Sewell 1999), the sociology of emotions (Collins 2004), passivity (Juffé 2003), and phenomenology (Schutz 1962). Although the primary focus of this chapter is on the teaching and learning of science in an urban school in NYC, we employ research methods that include ethnography, conversation analysis and video microanalysis. The methods are adaptive to what we seek to learn and zoom from micro, through meso to macro/global as we examine social life in relation to a structural flux that is global in extent and affords local actions as culture is produced in fields of activity. We adapt activity theory (Roth and Lee 2007) and numerous Bourdieusian constructs from reflexive sociology (Bourdieu1992), especially fields, which are regarded as unbounded sites for cultural production (Tobin 2007b). Activity occurs in fields and, as I indicated above, multi level analyses are undertaken.

Except for Chris, and Ashraf and the authors of the chapter, pseudonyms are used for all participants in the study and the name of the school.

Cogens at NYH

The population of the Bronx, now more than 1.3 million, is diverse ethnically—36% Black and 30% White. Forty eight percent of the inhabitants are Latina/o and it is reported that there are more Puerto Ricans in the Bronx than in any other county in the United States. Also, 10% of the residents of the Bronx are Dominicans. Steady population increases are high due to natural births and immigration. The area of 42 square miles is relatively small, hence the population density is high and the inhabitants are disproportionately poor and working class. In fact, approximately one third of the households in the Bronx have an income below the Federal poverty line and the per capita income is about $14,000.

NYH was in its second year of existence when I first joined the faculty as a chemistry teacher. Standing outside the door of my classroom, on my first day of teaching at the NYH, I watched the students wearing blue scrub tops with much anticipation that this would be a good year to start doing science with these new faces. Indeed, it was one of the best in my fourteen years of teaching experience in New York.

There were 410 students from grade 7 through grade 10. The school population comprised 29% Black, 66% Hispanic, 2% White, and 3% Asian students, including 12% English language learners and 13% special education students. Boys accounted for 19% of the students enrolled and girls for 81%. The average attendance rate was 91%. The school is in receipt of Title 1 funding with 84% eligibility.

The science program was designed such that the 9th graders took conceptual physics first, followed by Regents chemistry in the 10th grade and Regents living environment in the 11th grade. Students were distributed into cohorts based on their math skills, English proficiency levels, and special needs.

Four cohorts were created among all the 10th grade students taking chemistry. Most of the advanced students were placed in cohort 10A, English language learners were assigned to 10B, transferees and new admits were in 10C, and those with special needs were placed in 10D. Students in all cohorts received Regents chemistry instruction for the whole year with an after school program being provided to students needing additional help and reinforcement.

Classroom instruction was very much driven by the NYC Scope and Sequence and the New York State Core Curriculum on Physical Setting/Chemistry. Each month, students received a calendar that outlined all the major concepts to be covered. Every six weeks, students received progress reports that were averaged from their test performance, class participation, laboratory activities and projects.

Physical models produced by the students as projects were used to reinforce the learning process. Many students who did not do well on written tests passed the course by showing their understanding of the chemical concepts through their creativity in producing projects. These projects were displayed on bulletin boards outside and inside the classroom.

The first few weeks of teaching were more of an adjustment—getting to know each other. As we moved from the introductory part of Regents chemistry course to more abstract concepts, problems started to emerge. Students in 10B and 10D became disinterested and disengaged from the lessons. Also, I started having problems with the English language learners and special education students. They became more talkative in the classroom and did not complete assigned class work. Complaints about chemistry as a very difficult subject were shared among students.

I started using cogen in all my chemistry classes. I identified five student leaders to coordinate our plans and together we learned how to enact cogens in the classroom and in the laboratory. The use of video cameras in the classroom was well received by the students. They became more interested in seeing themselves interacting with one another; teaching each other; and becoming more productive in doing laboratory activities. I embraced cogen as my primary approach in reaching out to students who had issues and difficulties in learning chemical concepts. I became a teacher-

researcher and immersed myself in observing the transformation that happened in our classroom as a result of enacting cogen.

Christopher Emdin was the first teacher researcher to enact cogens with his grade nine physics class. When this freshman class graduated the students moved on to study chemistry with Rey, who became a teacher researcher and occasionally cotaught chemistry with Chris. The students were accustomed to cogens and readily enacted them in the chemistry class, though not in precisely the same way. As a new teacher researcher, Rey introduced some of his own ideas, notable among them being a buddy system.

Rey established an academic buddy system in which students involved in cogens selected one or more buddies with whom to collaborate. It was not left as an informal arrangement. Rey changed the reward system to advantage students who actively participated in the academic buddy system and he wrote to parents informing them that the system had been formulated and enacted. Students would earn 20 extra points for each buddy they took on and Rey emphasized the creed that "you do not allow another to fail." There were numerous reasons for creating a buddy system. For example, students were repeatedly absent from school, came late, frequently left for visits to the bathroom, lost focus in class, disrupted others (including the teacher), and got themselves suspended for violating school rules. Furthermore, homework was not done or was not done well and work that was done in class was not submitted to earn participation grades. Rey felt that a change of roles would support learning while developing the right emotional climate and a sense of family among the participants in his class. As a Filipino immigrant he was aware that the students experienced his teaching through deficit lenses—a foreigner with an accent. He realized at once that there were advantages in him teaching in Spanish (or Spanglish as he called it) and allowing students to tutor one another in their native language.

A buddy group comprised a social network. In class the students sat together and assisted one another to be successful. Not surprisingly, buddy groups set the stage for coteaching. Initially, students within a buddy group tutored one another. However, when Rey was teaching, students often had difficulty with his Filipino dialect. When this occurred, they assisted one another to understand what he was saying. Accordingly, students would interact softly while Rey taught from the front of the class. When it was necessary to do so, students from a buddy group would come to the chalkboard to clarify something Rey had been teaching.

It is not a surprising outcome that coteaching emerged from the use of cogens and an academic buddy system. Consistent with a dialectical relationship between teaching and learning, students tutored one another, redirected one another when focus was lost, and clarified Rey's oral texts when they could not understand his accent. Rey invited buddy groups to present project work to the class and once students experienced being at the font of the room and using the chalkboard and projection tools there was no stopping them. Students not only cotaught together, but they also cotaught with Rey, including Lily, who cotaught during a Regents review class undertaken on the weekend.

How to learn more about chemistry by coteaching others was the driving force many students internalized in their own selves as we prepare for the Regents chemistry exam. Students were actively involved in coteaching each other. Student leaders in 10A and 10C volunteered to coteach students in other sections during Saturday review sessions. Other students went to one another's homes to finish group projects and do study sessions with their assigned buddies. We continued to view our video tape recordings and together we celebrated our accomplishments in learning chemistry.
I started pairing up the advanced students with those labeled "at risk." Students who seemed to look helpless in their day-to-day attendance in chemistry class became active participants in their respective groups, especially when they got help from the other advanced students whom they trusted. Positive emotional energy and solidarity were evident in the students' actions and interactions as we continued to dig deeper in understanding more abstract concepts. The videotapes captured several instances when and where students in a group enjoyed sharing their talents and skills in doing science.

What happens in a typical cogen?

In the third year of high school the students who had previously studied science with Chris then Rey, studied the Living Environment course. Their teacher was Mariona (referred to by students as Ms. T), in her first year of teaching science. Although the students had used cogens in the previous two years, Mariona did not use cogens initially. However, as problems in the class became more numerous the students who had been most involved in the cogens approached Chris, who was now a university professor and still involved at the school on a regular basis, about using cogens to improve the science class. Chris approached the teacher, Mariona, who readily agreed to enact cogens. In addition to two male and five female students from two classes, the participants in the cogen included thee adults, Mariona, Chris and me.

During the first cogen many of the problems associated with the class were discussed and the cogen group agreed to enact a game show format for the next lesson based on the TV show Jeopardy. As an example of the interactions and transactions that occur, the second cogen conducted in Mariona's class is analyzed in the section below.

As we moved the furniture into an ellipse, all participants appeared relaxed and engaged in informal conversation until Chris initiated a formal dialogue by raising the volume of his voice and providing a welcome and a description of why we were meeting and how we would function. After reminding participants of the rules we would follow in the cogen one of the students asked whether the focus would be on the class or the instruction. As I puzzled over what the student meant, Chris quickly resolved the issue by saying, "both." With that José initiated a discussion on what he enjoyed about the particular class he had just completed. In his remarks he touched on the class being interesting, getting everybody involved, and his enjoyment of the game show format.

While agreeing with José's general statements, Loida personalized the lesson when she described a segment she did not enjoy and her annoyance at incorrectly answering a question on pathogens. Her comments were somewhat typical of many she made in cogens—pointing out her shortcomings as a student while insisting that she learns from her mistakes. On this occasion Loida showed that she could elevate the emotional energy of the group by making self-deprecating humor that catalyzed collective effervescence in the form of laughter. Although the participants, including Chris and Mariona, had laughed together earlier in the cogen, Loida's short turn at talk provided several opportunities for cogen participants to laugh together. Also, since Loida raised the topic of pathogens, students used the opportunity to seek clarification from others.

In a discussion that involved everyone except me, all students asked and clarified issues and both Mariona and Chris gave explanations about molecular geometry and the functions of antigens, antibodies and vaccines. Prescilla also played a leading role in explaining the science, using iconic gestures to depict the chemistry. With the exception of the elaborations from Chris, Mariona and Prescilla the turns at talk were short, highly interactive and often choral as students talked together and engaged in simultaneously unfolding conversations that focused on a common set of issues. Finally, Chris wrapped up this important tutorial when he commented. "Lock down. Lock it down." The remark amused Sarah who appreciated its double entendre, being reminded of lyrics from several of her favorite music groups (e.g., see youtube.com, Digital Assassins and Freeway) while appropriately describing the ways in which antigens affect an immune response.

The following transcript shows some elements of the prosody of a 16s vignette in which the participants finalize what amounts to a tutorial on antigens. The entire group participated in the conversation, which reviewed antigen, antibody, pathogens, vaccines and structure, especially the way in which the antigen provides a cover to protect the spread of a pathogen.

Figure 1 is an offprint from the videotape of the cogen. The moment in time is immediately after Chris uttered "Lock it down." Capture on the participants' faces are collective expressions of enjoyment and evidence of entrainment. Mariona adopts a relaxed pace in a cogen in which she is ethnically different from all other

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Chris: … so that's the antigen (2.3s) [After the pause Chris
strikes his hand on the desk (0.3s) making a clunk clunk sound,
the second clunk being much louder then the first (82 db) He then
speaks emphatically.
Chris: Lock it down [down has an intensity of 79db]
Sarah: Laugh [huhu] (0.3s)
Sarah: Yeah. Lock it down (0.2s)
Chris: Yeah=
Mariona: huhu=
Chris: I, I like the way it's cool [students overlap and
interrupt]=
Sarah: That's good. Lock it down. The way you said it. Lock it
down=
Chris: It's cool you're talking about the cover and the …
[difficult to decipher]
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participants. She learns to interact in culturally adaptive ways by being in the cogen field with other participants—that is, she learns passively. As Mariona develops a sense of the game, she participates fluently, anticipating her turn at talk, acting appropriately, and just in time. In this particular offprint there is evidence of a shared mood, mutual focus, and entrainment (i.e., all participants act in synchrony).

Figure 1. Collective effervescence and focus as Chris uses the term "lock it down."

Chris's role as leader in a group that contained the class teacher was salient during most cogens in which I participated during this year. He was no longer a teacher at the school and yet the students clearly regarded him with affection and assigned him high status. If he moved away from the group, as he did later in the cogen to accept delivery of the Chinese food we had purchased, the participants in the cogen regarded it as an opportunity for time out and relaxed in informal …

The power imbalance that favored Chris was a problem for cogen since his ideas tended to be reified. In the past two years we established cogens in which power was shared more equitably. The source of Chris's disproportionate power was symbolic—akin to charisma and withitness.

exchanges. On this occasion, Chris's remarks on locking it down were a signal for closure on the tutorial and a search for a new focus—we had effectively cogenerated a successful outcome and were ready to move on. Throughout this cogen Chris used language that reflected his growing up in the Bronx and his relative youth. For example, he exhorted students to, "let's keep it moving. Jazz it up a little bit," and "that's dope." Later he commented, "I think it's dope, are you clear about it now? For Chris to use such language was appropriate from the students' perspective because they knew he was a hip hop DJ, lived in the Bronx, and had grown up in a neighborhood that included the school. I point out here that I could not have used terms like "that's dope," without participants letting me know my use of the term was inappropriate (i.e., inconsistent with my identity).

As the group conversed to identify the next focus for the cogen, Mariona asked, "What can I improve on?" Several quick remarks assured her that she was a "good teacher." As Mariona turned her gaze toward Sarah, the student remarked, "I never liked science. Period!" Although Sarah made the comment with a big smile on her face, Loida and Prescilla were among those who playfully rebuked her. During the ensuing conversation the focus was on convincing Sarah that there were aspects of science that she did enjoy and whether or not she enjoyed science was just a matter of structuring the class differently. In the wide ranging discussion students used humor as they cajoled Sarah, pointing out that she enjoyed the TV program "House," which was about science. During this interactive dialogue Chris and others affirmed that they also watch and enjoyed the TV program. This shared interest appeared to be a structure around which positive emotions were produced and solidarity was reinforced. However, in a good natured and somewhat playful way Sarah resisted these attempts to convince her, pointing out that even though she participated in science, she did not enjoy the class. When pressed, Sarah agreed that she enjoyed the physics class, taken two years ago, and whether she enjoyed a class may reflect the teacher and the teaching. Once again the focus turned to, "Is it about the teachers?"

"You are a good teacher Ms. T." Sarah assured her science teacher who was seated next to her that her dislike of science had nothing to do with the way Mariona taught. However, the preceding conversation provided an opportunity for Mariona to be reflective about her teaching and she explained that perhaps she should co-relate science and health to an even greater extent that she did currently. As was the case with all exchanges in the cogen the dialogue was highly interactive and no one spoke for disproportionate lengths of time. Participants addressed the way Mariona taught and compared the teaching and purposes of the science and health classes. In all instances students supported their preferences in terms of whether or not they were interested in the topics and their enjoyment of the class. The conversation also encompassed previous science classes, not just at NYH, but also at middle school and even elementary school (in one brief instance). This segment of the cogen included lots of laughter, quick talk and short bursts of speech. There were numerous examples of multi-person talk and overlapping speech.

The focus on Sarah not liking science moved to include her interests out of school. Principal among these were steel drums and music. This was clearly an interest she shared with Chris and provides an explanation perhaps for the numerous examples of her smiling when Chris used expressions from contemporary music in his utterances (e.g., lock it down). Several times in the ensuing conversation about Sarah's interests in steel drums Chris mentioned "chemical calisthenics" inquiring whether Sarah had heard it yet. Chris suggested that the class could create a beat and a rhyme, similar to what was done in chemical calisthenics. As the group discussed this possibility animatedly, Chris moved the group to focus on hip-hop and "how do we go about doing this?" Quickly a division of labor was agreed to and it was decided that one group of students would create a beat and the other would produce the lyrics. Since the next topic of study was to be genetics there was a consensus that this would be an ideal topic.

Mariona then suggested that the students also could make a podcast, creating an audio file and then making it available for students as a learning resource. In making the case for this activity Mariona pointed out that most of the podcasts she accessed were audio and did not incorporate video, giving an example that she had recently used in class, concerning the planting of a bean seed that was more than 2,000 years old. The cogen group liked this idea and also liked the idea to produce a podcast that incorporated video. Once again Chris pushed the group to the details of, "how do we do it?" After briefly re-visiting the previously discussed necessity for a division of labor to address the beat and the rhyme, Mariona suggested an initial task could focus on definitions for constructs like DNA, genes and chromosomes. After one of the students volunteered to do the first verse, a division of labor involving the entire group was formulated.

During these high verve interactions there were moments of asynchrony, especially when I ventured an idea. My rate of speaking was much slower than others, even when I consciously sped up my delivery. I suggested that, rather then Mariona creating the questions for the quiz show format, the students could contribute the questions and this could be worked into the assessment system. There was little support for this idea and a lull in proceedings until Chris declared it to be a "dope idea," noting that we could look at the tape together, identify the questions raised by students in class, and use them in a Jeopardy format in subsequent test preparation lessons. However, before all participants agreed to this idea and planned appropriate action, Sarah asked Chris: "Why don't you offer tutoring in biology?"

Capturing the results of students' experiments through video cameras fostered their interests in the lessons they considered difficult. My students became more focused in exploring laboratory activities. Together, we watched our video recordings during cogen and extracted good snapshots that were displayed on our bulletin boards. During cogen students started to discuss how else they could improve their scientific inquiry skills, and data organization and presentation. As we continued to dialogue and plan to improve our classroom activities, I noticed that students naturally regrouped themselves and continued to discuss chemistry concepts even outside the school building. Students began to use the chemical terms as part of an evolving student language. I encouraged them to talk chemistry with their friends and family and to continue the conversations even when they were in buses and subways.

When Chris reminded the group he no longer taught at the school, Sarah asked a more general question, "How come we don't do tutoring?" Mariona again alluded to her own inadequacies as a teacher, pointing out that she may not connect with everyone and there were benefits in having a different person tutor science topics that students did not understand from classes taught by Mariona. The group accepted this idea and Chris pointed out that just as they had done today in the

This is an important example of involving students as coteachers in small group tutorials. If tutorials are planned as cogens the potential outcomes and anticipated levels of success might be expanded considerably.

conversations about antigens, cogens could serve the purpose of being tutorials. The participants quickly agreed that this was a good example of the value of cogens, an aspect that could be continued in subsequent cogens. However, the cogen participants wanted an activity that would benefit more than those involved in the cogen.

Mariona suggested coteaching as a possibility and students reminded all participants that the buddy system was highly successful when they studied chemistry with Rey. The group then had a wide-ranging discussion on the value of the buddy system in their chemistry class and how it was organized. Chris then focused participants on creating a plan to enact the buddy system in this Living Environment class. The participants in the cogen agreed to pair a strong student with a weaker student and ensure that assigned grades would reflect not just individual performance but also improvement in the grades of assigned buddies—"If your buddy's grade goes up, yours goes up too."

The conversation included the value of assigning buddies across the constituted classes, which were tracked. Chris noted that conversations out of class usually did not include understandings of biology, stating that, "they kick it every day after school" but do not help one another to be more successful in their classes. After a lively conversation about whether or not it was advantageous for out of school friends to be assigned as buddies, a consensus was reached to adopt this procedure and that students in 11C could benefit from having a buddy in 11A. Assigning buddies across class groups was agreed to when Mariona gave an assurance that the topics being dealt with in 11C only lagged behind those being done in 11A by a few days. The cogen participants agreed that establishing a buddy system was a priority and the specific details would be worked out in the next cogen, prior to the upcoming examination.

My own changes highlight the potential of using cogens in professonal development of teachers across the career spectrum. By being in the classroom and cogens once a week for a number of weeks I developed a sense of the game that allowed me to anticipate and to get involved without having to consciously reflect on making sense of the dynamic flux of structures. Over time I did not have to disrupt flow by asking students to repeat what they said and I did not misinterpret high-energy interactions, prosodic patterns, and bodily movements. My regular involvement in the class and the cogens allowed me to successfully participate in each and greatly expanded my teacher agency.

Does the use of cogens increase achievement on high stakes tests?

So often the bottom line in classroom research is whether or not changes occur to improve achievement, especially on high stakes tests. For example, in NYC, students must pass the State Regents examinations in five specified subject areas and at least one Regents examination in science. Accordingly, if research is undertaken in high schools in New York a question that is always on the table is whether or not the study contributed knowledge related to increasing achievement, especially as it is measured on the Regents examinations.

We were interested to see if participation in cogens was an affordance for increasing achievement in science. Accordingly we undertook a longitudinal study involving 67 students who commenced grade nine in fall 2004 and studied one year each of physics, chemistry, and living environment. Rey taught all of these students chemistry during their sophomore year. For the purposes of studying achievement in science we examined the grades awarded by their science teacher in each of the first three years and their cumulative grade point average (GPA) based on four years of high school participation. We did not use inferential statistics in our analyses because of differences in the group size and participants were not randomly assigned to groups. Instead, in grade nine five students were invited to assume leadership roles in the use of cogens and 17 students volunteered and continued their participation across their four years of high school. The remaining 45 students are those who were taught chemistry by Rey, began high school in the fall of 2004 (the first year of the school), and studied the Living Environment course with Mariona in their junior year. The 67 students are regarded as participants rather than a sample from a larger population to which we generalize what we learned from this study. Hence, our analyses of the means and standard deviations are not considered different than other ethnographic analyses undertaken in this research. We systematically examined aggregated and disaggregated data in search of patterns and associated contradictions.

When the students were in ninth grade physics those selected initially to participate in cogens differed from one another in terms of their achievement, motivation to succeed, and other factors such as their attendance in class and the extent to which they disrupted others.

Achievement trajectories

In Table 1 the achievement profiles for the five core participants show that Lily, Sarah and Tiara were high performing in physics and Prescilla and Loida were lower achieving students.

Table 1. High school science achievement of the cogen leaders

Course	Lily	Prescilla	Tiara	Sarah	Loida
Phy 1	96	76	96	89	55
Phy 2	100	76	96	100	79
Ch 1	90	95	95	85	85
Ch 2	90	90	96	90	85
LE 1	95	93	94	85	85
LE 2	95	90	90	P	85
Elective	94	80	85	90	85
R Ch	64	68	72	67	55
R LE	74	75	76	76	67
Cum GPA	93	83	91	89	75
Credits	48	47	42	43	51

The lower achieving youth had a variety of emotional issues that tended to mediate school achievement. For example, after residing with her grandmother, Loida decided to move out to live with her boyfriend in a homeless shelter. In the year in which she studied chemistry Loida considered dropping out of school to get a job. Prescilla also was in danger of being a high school drop out. In her freshman year of high school Prescilla was disruptive in class and resisted her teachers' efforts to constrain her boisterous ways of acting in their classes. Her disruptive practices showed in her grades. In 2004 her term 1 average was 72% and her term 2 average was 76%. In the conceptual physics course she earned 76% in each semester. In contrast, in 2005, when she took chemistry with Rey, her class achievement scores were in the 90s. Prescilla became a close study-buddy of Loida in their chemistry class, assuming the role of a big sister to Loida, not only in their chemistry class but also in other subject areas. Prescilla maintained relatively high scores in her science courses and became a student leader. Throughout the final three years of high school she regularly participated in cogens, after beginning in the second semester of 2004. Her cumulative grade point average at the end of high school was 83%, just above the peer group average of 81% (i.e., based on the 67 students included in this study).

All five cogen leaders graduated from high school and are now studying at College. Prescilla and Loida both started as low performing students and elevated their achievement levels to graduate from high school, including passes on two Regents examinations (chemistry and living environment). Prescilla also excelled in school leadership, becoming President of the student council.

The 17 students who participated regularly in cogens had a slightly higher grade 9 GPA (i.e., part; Mean: 82.5; SD: 9.5) than students who rarely participated in cogens or did not participate at all (i.e., non-part; Mean: 75.9; SD: 8.2). Probably due to the way they were selected (i.e., three high achievers and two lower achievers) the grade 9 GPA for the leader group (Mean: 77.8; SD: 13.0) was not especially meaningful, although it was calculated to be between the non-participants and the participants. Table 2 contains descriptive statistics for each test broken down for each sub-group and the total group.

Table 2. Science achievement for students who did and did not participate in cogens.

Group		Phys 1	Phys 2	Chem1	Chem2	LE1	LE2	Cum. GPA
Non-part	Mean	77.6	81.9	77.2	78.3	74.2	75.3	78.8
	N	45	45	45	45	45	45	45
	σ	10.1	9.6	9.1	6.8	11.9	12.4	7.2
Part	Mean	84.8	88.7	84.2	85.1	82.8	82.4	84.9
	N	17	17	17	17	17	17	17
	σ	11.2	8.9	10.3	9.0	12.8	12.6	8.6
Leader	Mean	82.4	90.2	90.0	90.2	90.4	89.0	86.2
	N	5	5	5	5	5	5	5
	σ	17.4	11.8	5.0	3.9	5.0	4.2	7.3
Total	Mean	79.8	84.2	79.9	80.9	77.6	78.1	80.9
	N	67	67	67	67	67	67	67

σ	11.3	10.0	10.0	8.2	12.8	12.7	8.1

Several trends are striking. First, with the exception of the first semester of conceptual physics the leader group attained a higher average achievement than the participant group and the non-participants. Hence, participation in cogens was associated with higher achievement in science for the teacher made tests. We do not imply a causal relationship because the participant group had higher achievement averages from the outset and the core group was selected on the basis of their differences. Perhaps the key issue to reinforce is that participation in cogens for the relatively low achievers is associated with an increase in achievement, a pattern that is consistent with increased activity in class and the adoption of additional roles in science and in other aspects of school life. The new culture that evolved through cogens may have provided the low achievers with sustained motivation to keep up with the high achievers. From the ethnography it is clear that they set their own high standards to achieve.

Turnkey activities

The cogen leader group and cogen participants, who had four years experience of doing cogens, agreed to coach other students and teachers in how to enact cogens and what benefits to expect. With Chris and me they visited grade nine classrooms and explained the nature and value of cogens to the students and their teachers. Among the benefits Prescilla noted that, "Cogens. They're cool. You know, you start off within a small group. It can't be a big group. … That's how you know you're mature enough like when you get picked to be in a cogen because that's when you know that you can listen to somebody else's voice and not cut them off. You get to meet a lot of people … go further in life." Loida addressed the benefits of coteaching, commenting that, "students teach each other. That helped me a lot. Better for me to understand a lesson being that I heard it from students rather than the teacher. It's pretty weird but it is." Comments such as these were repeated to the teachers and students of each grade nine class and to science teachers who had not previously used cogens. Then the seniors conducted a trial cogen with four to five students while their teacher circulated the room with Chris and me.

A feature of the turnkey events was the responsibility assumed by these graduating youth for the quality of education at their school. They showed a lot of pride in speaking candidly to the youth in junior grades and speaking forthrightly to teachers who often were reluctant to get involved in using cogens, especially if it meant listening to complaints from students whom they viewed through deficit lenses (e.g., why should I listen to the student who don't turn up, come late, and listen to their music instead of doing their science?).

The ripple effects of cogens

The effects of enacting cogen in my chemistry class did not happen by chance. The students who experienced cogen during their 9th grade physics class were instrumental in enacting cogens in my 10th grade chemistry class. The production and reproduction *of expanded roles in learning science, and the eventual transformation of students and teachers to be more agentic in creating a repertoire of effective learning strategies were just a few of the many positive outcomes in this beneficial activity. Of the 32 students who ventured to take the Regents chemistry exam, 28 passed. The other students, who opted to take the exam at some other time, continued to show interest in learning science.*

After five years of using cogens at NYH they are still being used by some of the teachers there. Also, Chris and his graduate students are involved in ongoing research on the uses of cogens. However, despite the successes we have documented through intensive and ongoing research and plans that have included the school principal and other school leaders the buy-in among the school administration may not be sufficient to expand and sustain the use of cogens in the school. To a marked extent Rey, who is unlikely to return to teach at the school next year, has been the most consistent user of cogens and has worked with his colleagues to reap the benefits on a school wide basis.

One of the reasons might be that the science department is mainly composed of young teachers (1-2 years teaching experience) and they spend most of their time learning the nuts and bolts of teaching. Although they see the beneficial outcomes of cogens, they couldn't find time yet to implement cogens in their classes.
It is my view that for other teachers to appreciate the beneficial outcomes of cogens, they, together with the students have to experience the production, reproduction of cogenerated agreed-to changes in schema and practices, and the overall transformation of the whole class. The motive to initiate cogens should come from within the teachers themselves. Teachers must adopt a stance on why and how to teach. The first cogen for a teacher should reconcile inner contradictions.

When the initial group of cogen participants graduated as seniors, their efforts to turnkey the use of cogens gave hope to the idea that students could assume responsibility for collective achievement and act to create structures that afford engaging curricula and high achievement that would continue after they have left the school. Evidently the educative authenticity of our research efforts does not measure up to our goals. As a research group our motives were to disseminate what we learned from the research throughout the school and a cluster of schools that embraced similar goals. NYH, one of twenty-two New Century Schools funded by the Bill Gates Foundation, adopted ten principles of effective school design. Notably, instructional leadership by the principal and other school leaders is characterized by a school wide focus on student achievement; support for improving and enhancing school culture, teaching, and learning; and effective collaboration among school leaders, teachers, parents, students, and partners in the community. Whereas the use of cogens propelled NYH toward achieving this goal, it is not clear that their use, even in an adapted form, has been institutionalized.

Outside of NYH and the other specific sites at which cogens have been enacted, the ripple effects are discernible. Since we began our research in New York, in June of 2004, there has been a steady increase in the number of studies incorporating the uses of cogens in an increasing number of fields, including special education students in a district that caters to their learning needs, special education students within schools such as NYH, mathematics classes in a variety of urban schools, technology classes, museums, college science classes, and graduate classes in a variety of colleges, including teacher education programs (but not exclusively so). Each of these projects is a multi-year study and, just as occurred at NYH, the results suggest improved performance of participants and willingness to institutionalize the use of cogens.

A realistic assessment of what is happening must look past the students, teachers, school leaders and professors involved in the research. Macro structures mediate what happens in schools. For example, school administrators and faculty are held responsible for the quality of the school and for the most part the quality of high schools is assessed on the basis of performance on the State Regents examinations. In 1989 the State of New York initiated a program called School Under Registration Review (SURR) to identify potentially failing schools, give them a chance to meet standards and, if they do not, to shut them down. City and State resources were allocated to improve the performance of schools on the SURR list. About 70% or more of the schools listed as SURR are from NYC and more than 20% were turned over to private firms. Many elements of the program are controversial and eight large high schools from the Bronx have been closed, allowing smaller schools to be constituted within the same building. One of the schools that closed because of the SURR program now contains NYH.

NYH and another new school are situated in a building that previously was a junior high, one of the oldest and most prestigious in the Bronx, with a proud history of accomplishment in sports and academics. As the ethnic composition of the Bronx changed in the 1990s, due in part to an increase in the numbers of immigrants, the reputation of the school declined and it was identified as a failing school, placed on the SURR list and, when it did not improve sufficiently within three years, it was closed.

It is something of a contradiction that participation in cogens appears to increase student achievement on the Regents examinations by producing collaborative approaches to teaching, learning and curriculum design and enactment. Yet, the powerful logic that pervades education in the US is that doing well necessitates a clear explication of goals and standards, a focus on learning the standards, and passing tests of achievement. Alignment of standards, classroom practices, and assessment are frequently advocated for success; holding individuals accountable for performance is a widely accepted ideology. Similarly, meritocracy is accepted as the basis for achievement and issues such as class, race and ethnicity are not included as social categories in models used to predict achievement. Indeed the NCLB act is seen as a safeguard against individuals and schools that might use social categories like these as reasons for not doing as well as other schools.

Considerations of high quality education have an alarming tendency to focus entirely on the bottom line, which is high achievement on statewide and city tests. This tendency is no doubt fuelled by mandates from policy makers and school leaders which effectively hold schools, and thereby teachers, accountable for student achievement on tests. Resources within schools, such as time, space, materials and people tend to reflect such policies and test prep programs are common. Such a focus on procedures for taking tests, responding to items and learning facts needed for mastery distorts a science curriculum, narrows the possible goals and motives, and similarly restricts the desirable outcomes that are accomplished by most participants. Furthermore, by limiting the range of teacher and student roles to those associated with higher test achievement, there is a danger that the curriculum will be so focused on exam performance that insufficient opportunities are provided to attain worthwhile goals that are not easily assessed by the examinations.

For example, identity is an important outcome of a school science program. What this means is that students who study science should produce an affiliation that connects their sense of I and me with science. As a form of symbolic capital an identity in science can be thought of as belonging to a collective that does science. That is, science is something I can do, like to do, and am good at doing. Furthermore, science is regarded as relevant to the student's lifeworld, useful in meeting her goals, and contributing to the collective's motives.

Monolithic ways of theorizing science education may have been damaging to the advancement of scientific literacy, especially in urban schools where differences among students are pervasive. These differences are evident between and within schools and in comparisons between science teachers and their students. Unfortunately the symptoms of these differences are visible in performance on high stakes tests such as those discussed earlier and in reactionary policies that aim at redressing achievement disparities. All too often difference is seen as otherness and policies and practices are aligned to produce equity around sameness. Rather than finding the capital in differences among students, deficit perspectives are used as rationale for building valued standards based on tabular rasa. Failure to build learning environments that allow students to fully deploy what they know and can do is a serious handicap and a continuous fog of social violence that envelops urban classrooms. Rather than tailoring enacted science curricula to the cultural, social, and symbolic capital of urban youth, efforts are made to reproduce learning environments that mirror the best of mainstream USA—usually what we might expect to see in the best schools in the suburbs.

Research that takes a different stance is relatively rare, even though our sociocultural approaches have spawned centers of research, development and practice that value difference and enact science education from an explicit standpoint of social justice that includes the production of solidarity based on cultural differences.

What next?

On the basis of what we have learned about cultural adaptivity growing in cogens there is a theoretical basis for assuming that similar outcomes would occur if representatives from other fields participated in cogen. Already we have seen that school leaders can participate in cogens with teachers and students to successfully negotiate changes to address school level problems. Successes like these support the assertion that cogens might be used to address problems at the district, state, and national levels. No doubt adaptations would be needed, but if the goal is to achieve success and produce solidarity while addressing collective goals, then the cogen field should afford the production of culture that can be used outside of the cogen field to restructure/transform those fields and disseminate improvements.

A concern that I have addressed elsewhere concerns the global dissemination of US science education (Tobin in press). Ever since I have been involved in science education (more than 40 years) and prior to that, curriculum resources, including syllabus descriptions, textbooks, lab manuals, teachers' guides, and films have been exported globally. Largely due to the marketing of graduate education by US universities a steady stream of graduate and post graduate students study science education in the US every year. As Ogawa noted in relation to science education in Japan, some aspects of Western Modern Science can be hegemonic, especially in regards to the practice of Shizen, which is culture pertaining to valuing, coexisting with, and sustaining nature (Ogawa 2001).

Irrespective of who is involved in cogens it is important that a critical perspective is adopted in which participants engage in reflexive practices, becoming aware of culture that may be oppressive to certain sectors of a field. By becoming aware of oppression and possible relationships that produce and sustain disadvantage (i.e., schemas and practices), potential hegemons can be identified and become objects for transformation. Adoption of the authenticity criteria described by Tobin (2006) affords ontological changes of all participants, and education regarding others' cultural enactments including their axiologies. We expect that participation in cogens also will catalyze positive changes in the operation of the cogen and the target fields and afford all participants in cogens the benefits of being involved, irrespective of their positions in social space.

One of the assumptions that cogens challenge is that an individual or collective can set goals for another without successfully negotiating these goals with her. It seems foolish to assume that curricular goals can be set up for another without that person being involved in cogenerating them. And yet this is what is done almost always in US high schools, including in science education. Curricular goals are handed down from those in authority and are a form of cultural imperialism. On the basis of research undertaken to this point in time, mainstream groups achieve success in science education to a greater extent than social minorities. If cogens were regarded as methodology—a theoretical framework for generating methods of developing curricula …

that incorporate students' input connecting their interests, culture, uniqueness and creativity for real-world applications.

… it is possible that alternative models would emerge and science education might become more culturally adaptive.

The dialogue should allow participants to tell their stories about their experiences in science education. Participants should be encouraged to describe their lived experiences using their own frameworks, narratives, metaphors, and modes of representation. As participants listen to one another's stories they can question/comment and evaluate what is said with the purpose of promoting a respectful, reflexive dialogue that affords ontological change and education. Such a dialogue can provide a foundation for cogenerating agreed-to change. It is important in this process not to expect individuals to adopt the stories and frameworks of powerful (persuasive) others. A reasonable expectation is to understand where others are coming from, respect their rights to be different, and take account of their culture when changes for the target field are cogenerated. Basically, what are generated are potential structures taking the form of responses that would be available to support activity in the target field. For example, new roles might be planned for individuals, new rules might be formulated for a class, new resources might be planned and developed to support activity, and individual and collective goals might be produced.

Benefits of cogens

One of the most striking outcomes of cogens is the way in which participants learn to enact culture to produce success within the cogen field. Notably, success occurs between individuals who typically enact very different culture. From the very beginning we set up cogens to include participants who represented difference in social categories that were salient to the classroom from which they were selected. One of the very first categories of difference that was related to asynchronies was age. The teachers were older than the students, spoke differently, had different interests and hobbies, and used different expressions in their turns of talk. Over the course of several cogens we observed a higher incidence of successful interactions, more synchrony, and more focus on the activity of the cogen. That is, there were fewer shut downs, i.e., breaches in the flow of cultural enactment. Participants produced culture that afforded entrainment and cultural fluency.

An early problem occurred with a male teacher who emigrated from Egypt (Shady 2008). His students were nearly all African American and we noticed that the expected production of success did not occur when he used cogens to address some problems in the teaching and learning of science. The dysfunction of the science classroom was reproduced in the cogen. In an endeavor to resolve the problem, Shady systematically reduced the number of participants in cogens, first to three and then to two—Shady and one other student.

In a two person cogen the participants were able to produce some successful interactions and over time the social bonds that developed were a foundation for developing other forms of symbolic capital, including trust and respect. Shady found that, after undertaking one-on-one cogens with several students he was able to include them in cogens involving more students. Then, he began to experience the culture produced in the cogens being transferred successfully to the classroom. In Shady's case we became aware of the importance of ethnicity as a resource for cultural difference that produced othering and an associated lack of respect (Anderson 1999). Too often misinterpretations of cultural enactment produced lack of trust, disrespect, and refusal to participate (e.g., silence, body posturing, exasperation, efforts to humiliate and shut down others). Through his willingness to listen and respond to students' problems, Shady demonstrated sincerity, empathy, caring and persistence to succeed in the face of failure. Also, he showed he was willing to strive for success in spite of students' repeated efforts to disrespect him. His consistent efforts to assist students in the cogens were reciprocated when students "had his back" in the science classroom. Social bonds, networks, trust, and respect all contributed to the production of loyalty and solidarity.

At much the same time that Shady was solving the problem of how to structure cogens to produce successful outcomes, the research at NYH entered its second year. Chris reported in meetings of our research squad that he had started to coteach in the chemistry class with Rey, and had initiated cogens to address some of the problems Rey was experiencing in his teaching of the students Chris had taught the previous year. At least some of the problems Rey experienced were associated with ethnic diversity. Within the students there were several ethnic groups and Rey, being Filipino, was ethnically other. Some students even showed their disrespect for his cultural otherness by referring to Rey as "Chino." During the weekly meetings of our research squad, that did not yet include Rey, we discussed a model of structuring cogens that would include Chris and Rey with some students. By being, in cogens with participants who had previously been involved in them successfully, we felt that Rey would learn how to be successful in cogens and would produce the capital needed for success.

My inclusion in the subsequent cogens made me empathize with the students that "chemistry is a difficult subject" and that I needed to differentiate my teaching; providing them with more concrete and relevant connections of the concepts to their lived experiences. Some students complained that I taught them as if they were already college students.

Chris had previously established strong social bonds and networks with the students and he was respected by them, trusted, and liked. As an African American, with ethnic links to the Caribbean, and shared interests in hip-hop, the cogens incorporated high levels of verve and positive emotional energy—including collective laughter. In an important sense Chris sponsored Rey's membership of the cogen group and ensured that he would be encouraged to speak, that he would be listened to, clarify when necessary, and assisted to succeed. No doubt the capital produced in the cogens in which Chris and Rey were both present provided Rey with stocks of knowledge that would afford success in cogens and in the chemistry classroom when Chris was there and when he was not there.

I was surprised to find that Chris had a Scottish grandfather—me too. When I was speaking to the students about ethnicity at the start up to a cogen I asked Loida about her ethnic background. She looked at me squarely and asked: "First Ken, what's yours?" Very astute, so often White researchers make an assumption that they have no ethnicity and they are researching a construct that is "strange" or other. Loida had the perception to know that if I had an interest in ethnicity I should have thought about it in relation to my own privilege and oppression—not just about her ethnicity and her privilege and oppression.

My experience with cogens at NYH was much the same as those described earlier in this section. As an Australian immigrant, I was ethnically different from everybody I encountered in the school. Also, I was older, spoke differently, and had a very different lifestyle to the teacher and the students. In the five years in which I have been involved in research at NYH, other resident teachers, including Chris, Mariona and Rey usually scaffolded my participation in cogens. The culture I produced in cogens was then available to me in the classroom when I interacted with students from the cogen and others. The social bonds and networks established in cogens were a foundation for expanding them in the classroom, and by producing appropriate culture at just the right time.

Are (co)learning and (co)teaching inseparable?

The first generation of research on cogens focused on altering the division of labor in science classrooms so as to mediate improvements in learning. To a marked extent the dialogues focused on changing roles to produce higher quality participation. Inevitably teachers and students adapted their practices and the results were consistently positive. However, negotiating changes that promise the right kinds of improvement and enacting them to produce the intended outcomes necessitate that many not so obvious forms of culture also must be produced and maintained. Increasingly it has become clear that emotions are central to creating and sustaining productive fields, such as cogens and science classrooms. When interactions succeed the emotional valence is positive and if positive emotional energy can be maintained for the length of a class period or the duration of a cogen then solidarity and affiliation can be imbued in subsequent activities in the fields.

Rey's idea to take the cogen into other fields through the creation of buddy systems shows how cogen structures can penetrate fields (of the lifeworld) to afford outcomes similar to those reported in this chapter. A buddy system is regarded as a cogen situated in fields such as recreation, hobbies, streets, and home. What Rey did in effect was to begin with a core cogen group and then each participant recruited buddies to participate in two person cogens, just as Ashraf did with students in his science classes. Rey's buddy groups greatly expanded the number of participants in cogens, produced culture that could be enacted in the science class, and expanded the opportunities for all students to participate and succeed.

Successful participation in cogens requires participants to stay focused on goals and motives and act in ways that afford others' ways of high quality participation. That is, a person's actions should intend to produce synchrony, entrainment and success. In cogens all participants act for others, that is, not only to meet individual goals and thereby contribute to the collective motives but also provide affordances for others to get involved appropriately and succeed. As we mentioned at the beginning of the chapter, successful action will always be both agentic and passive. Furthermore, if and when participants act in these ways they are simultaneously teaching and learning with others. We find comfort in a concluding realization that what began as two fields, coteaching and cogen, are theorized and enacted as constituents of a whole, the parts are inseparable and each presupposes the other. That is, to coteach is to participate in cogen and to participate in cogen is to coteach. The symmetry of our conclusion sheds light on the potential of following pathways that actively foster cogens and coteaching, including the possibility of these pathways being beyond urban schools and beyond formal learning institutions.

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