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Boundary Spanners as Bridges of Student and School Discourses in an Urban Science and Mathematics High School

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A key to improving urban science and mathematics education is to facilitate the mutual understanding of the participants involved and then look for strategies to bridge differences. Educators need new theoretical tools to do so. In this paper the argument is made that the concept of "boundary spanner" is such a tool. Boundary spanners are individuals, objects, media, and other experiences that link an organization to its environment. They serve critical communicative roles, such as bridges for bringing distinct discourses together, cultural guides to make discourses of the "other" more explicit, and change agents for potentially reshaping participants' discourses. This ethnographic study provides three examples of boundary spanners found in the context of an urban public high school of science, mathematics, and technology: boundary media, boundary objects, and boundary experiences. The analysis brings to the foreground students' and teachers' distinct discourses about "good student identity," "good student work," and "good summer experience" and demonstrates how boundary spanners shaped, were shaped by, and sometimes brought together participants' distinct discourses. An argument is made for boundary spanners' practical and theoretical utility: practically, as a tool for enhancing meaning-making between diverse groups, and theoretically, as a heuristic tool for understanding the reproductive and transformative aspects of urban science education.

Those of us who teach and research in today's urban schools and neighborhoods continue to learn that multiple interpretations of the practices enacted by youth in these settings are possible and that everyone's interpretation of these practices is constrained and filtered by unique cultural resources. New tools are needed to better understand and positively influence the educational experiences enacted in modern urban schools. In this paper we (the authors) propose a new lens for analyzing students' and teachers' distinct discourses to provide guidance and salience to educational features such as student identity, quality schoolwork, the value of science, mathematics, and technology, and the purpose of education. These discourses are mediated and given salience through different media, objects, and opportunities. We use our experiences working in an urban science and mathematics high school, the Center for Science and Mathematics (CSM), as the context for introducing the construct of "boundary spanner" as a theoretical tool for creating bridges between distinct discourses in diverse science education settings.

Since the publication of *Science for All Americans* (Rutherford & Ahlgren, 1990) there has been an ongoing debate as to how to prepare a scientifically literate society. One by-product of this debate has been increased attention toward promoting enhanced science education among traditionally underrepresented students in science and science education, including girls, students of color, students of poverty, and students with disabilities, all groups well represented in the population of today's urban centers. Our own thinking about urban schooling has been influenced by studies of ways urban educators have attempted to engage urban students successfully in science learning using lenses such as a funds of knowledge approach (Hammond, 2001), a caring community model (Seiler, 2001), models of parental and community engagement (Barton, Drake, Perez, St. Louis, & George, 2004), frameworks for creating inclusive science learning environments (Brickhouse & Potter, 2001), learning science as cultural border crossing (Aikenhead & Jegede, 1999), and models of coteaching (Tobin, Roth, & Zimmermann, 2001).

This scholarship emphasizes that the various interactants in urban school environments routinely lack even the most rudimentary understanding of the reasons for actions taken by other individuals within that setting. For example, Seiler, Tobin, and Sokolic (2003) pointed out that teachers generally assume when a student takes actions detracting from classroom

learning objectives that the student is making a conscious decision to resist the teacher's science-related goals. In fact, the student's actions may be driven by a wholly separate goal, such as earning or maintaining peer respect. If educators believe that an individual's actions conform to some internal group logic, then a critical step in improving urban science education is first to improve the mutual understanding of the actors and then to look for strategies to bridge these distinct and sometimes conflicting discourses.

Conceptual Framework

A variety of useful theoretical lenses, often highlighting notions of culture, have been applied to urban science classrooms. Our work often draws on practice theory (Davidson, 1996; Levinson & Holland, 1996) as a way to conceptualize both culture and identity (Buxton, 2001, 2005; Carlone, 2003, 2004). This cultural lens brings to the foreground the notion that, through participation in everyday practices of schooling, the educated person "*produces* cultural forms," but is also "*culturally produced*" (Levinson & Holland, 1996, p. 14, italics in original).

Elsewhere, Buxton (2005) described CSM teachers' gradually changing expectations about their students' knowledge of high quality academic work and the way teachers redefined their responsibility for making such a model of quality work explicit. Teachers and students who remained at CSM for more than 2 years came to share an increasingly overlapping discourse of academic success, while those who left the school within 2 years of arriving retained models of academic success largely incompatible with the models of those who chose to remain.

The present study evolved out of the desire to understand how these discourses increasingly overlapped with time. To do so, we needed new theoretical tools. Our new concept of "boundary spanner" is such a tool. Below, we develop the concept and provide a framework for understanding it.

Discourses

Gee (1999) distinguished between the big "D" Discourse and the little "d" discourse in theorizing language. Little "d" discourse refers to language-in-interaction, while Discourse refers to language and "socially accepted associations among ways of using language, of thinking, valuing, acting, and interacting, in the 'right' places and at the 'right' times with the 'right' objects" (p. 17). For example, a scientist presenting her work at a conference enacts a scientist Discourse. To successfully pull off being a scientist, she uses language according to prescribed norms (speaking in a technical, rational, emotionless way), but she also must think, act, interact, dress, and use tools in certain ways. Enacting a Discourse involves knowledge and use of specific *cultural models* or commonplace "storylines" about how the world works. For instance, a scientist's cultural model about nature depicts it as patterned and predictable. Though Discourses are tied to history and culture, they are not static. They get constructed in *similar* (not identical) ways, again and again, in interaction.

In this paper, two Discourses are of particular importance—the Discourse of the students at CSM (hereafter referred to as "student Discourse") and the Discourse of the school (hereafter referred to as "school Discourse" or "CSM Discourse"). Narrowing the lens further, we examine three different cultural models embedded within each Discourse—the cultural model of "good student," "good work," and "good summer experience." These cultural models were emergent rather than a priori theoretical constructs and are described in the findings section of this paper.

Boundary Objects

Boundary objects are inscriptions used to convey and integrate complex information too cumbersome to put into words (Roth & McGinn, 1998). These inscriptions, used across various communities of practice, coordinate face-to-face and distant interactions. Boundary objects most familiar to the academic community include the graphs and figures common in academic journals used to synthesize and express large amounts of complex information. We began this work with the idea that we might extend the concept of "boundary object" beyond its traditional use to understand how distinct Discourses of science and schooling were reproduced and transformed at CSM. Examples of such boundary objects are school posters, pictures, and slogans. However, we came to see that the concept of boundary "objects" failed to encompass the range of tools used to mediate differences in school and student cultural models.

Boundary Spanners

Conversations among the authors about boundary objects spurred connections to a similar concept in organization studies—boundary spanners. Organization scholars recognize that successful organizations exist with porous, fluid boundaries rather than as stable containers (Cheney & Christensen, 2000). One important way to link an organization to its environment is through the use of boundary spanners, "individuals within the

organization who frequently interact with the organization's environment and who gather, select, and relay information from the environment" to the key decision makers in the organization (White & Dozier, 1992).

Boundary spanners engage in various communicative activities. First, they provide crucial links to organizational outsiders that may stimulate reflection, assessment, and creativity (Aldrich & Herker, 1977). Second, boundary spanners often negotiate the goals of the organization with the desires of external audiences (Aldrich & Herker, 1977). Third, they select and filter what is more or less important to the organization (Adams, 1980; Aldrich & Herker, 1977; White & Dozier, 1992). Fourth, they engage in acts of meaning-making (White & Dozier, 1992), interpreting for internal and external audiences various behaviors, events, people, and information. This ability to speak several "languages" positions boundary spanners as potentially able to shift the language and meanings of a particular group.

We borrow and adapt the concept "boundary spanner" as a heuristic tool to understand better how to bridge Discourses of urban students and school Discourses. We downplay boundary spanner as a person in favor of anything that mediates and brings to the fore distinct Discourses and associated cultural models. We examine the potential of boundary spanners to shape and bring together urban student and school Discourses and the ways boundary spanners are also shaped by various Discourses. Figure 1 demonstrates these links.

The boundary spanner concept acknowledges the porous nature of urban schools as organizations, as well as the powerful ways in which contexts shape organizational activities and language. Applying the concept of boundary spanners, we posed two research questions:

1. What things (objects, media, tools, experiences) served as boundary spanners by highlighting distinct Discourses of potential students, enrolled students, and faculty at CSM?

2. How might these boundary spanners mediate distinct Discourses, bringing Discourses closer together and/or creating new Discourses?

In this paper, we consider the "distinct Discourses" to be the student Discourses and CSM Discourses that include different cultural models of "good student," "good work," and "good summer experience." We have both practical and theoretical aims in addressing these questions. Our practical aim is that by demonstrating a wide array of boundary spanners that served as communicative links between the mostly African-American, mostly economically disadvantaged, and mostly female students at CSM and their mostly White, middle-class CSM teachers, we will promote reflection about how others might use boundary spanners to narrow these historically stubborn Discourse divides. Our theoretical aim is to provide a heuristic tool for researchers interested in understanding both the reproductive and the transformative aspects of science and mathematics education in the modern urban school context.

Figure 1. *Three roles boundary spanners played at CSM.*
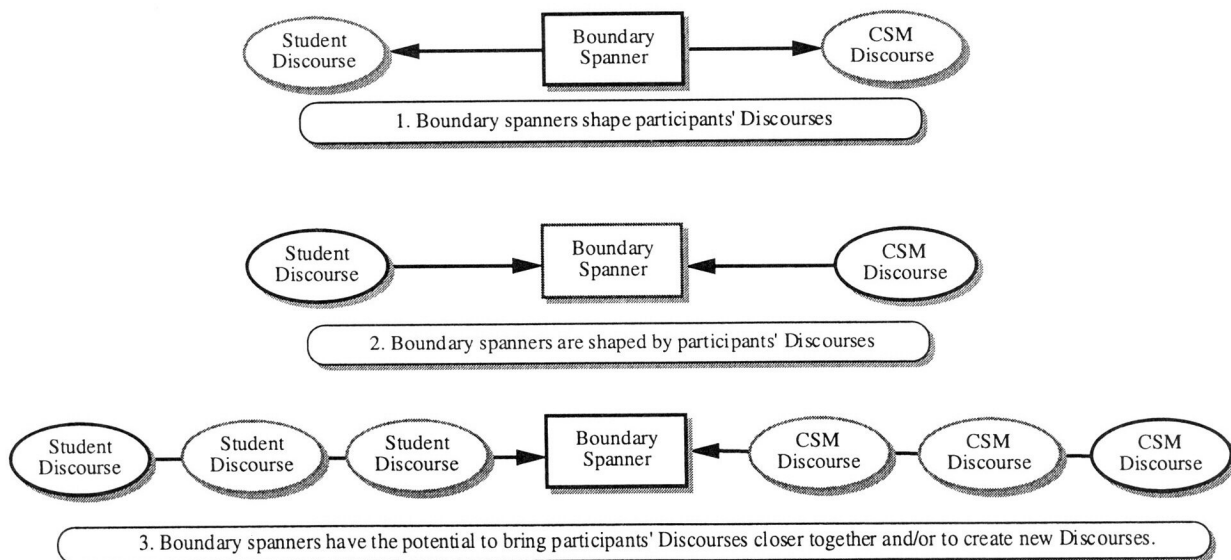
Methods

Setting

CSM was founded in 1993 in a large southeastern city as a public magnet high school by a small group of scientists and educators committed to providing interested students an opportunity to pursue rigorous studies in science, mathematics, and technology. The school's mission was to recruit students to CSM from all of the city's public high schools, where they would attend half days to take classes in science, mathematics, and technology and then return to their "home" high schools for the other half day for their remaining courses. One fundamental difference between CSM and nearly every other science and mathematics magnet school in the U.S. is that the admission criteria relied solely on a professed interest in science, mathematics, or technology and a commitment to "work hard," rather than on past academic performance or an entrance examination. For this reason, the school has consistently attracted students with a diverse range of interests, abilities, and academic preparation.

During the 2002-03 school year, 60% of the students came from home high schools that scored below average on statewide accountability tests, 90% of the students were African American, 68% were female, and 73% qualified for free or reduced lunch. The student body represented 30 different schools and nearly every city neighborhood.

Despite facing the challenges typical of modern urban schools, CSM has had a degree of autonomy for the past decade, as major policy changes drastically altered the practices of other schools in the district. For example, district-mandated daily "direct instruction" language arts teaching caused some of the home schools to cut back on science offerings, an obstacle avoided at CSM, since language arts was not (formally) taught there.

Data Collection and Analysis

The first author collected several streams of interpretive data over a 2-year period, focusing on the actions and interactions of students, teachers, and other school personnel across a range of social spaces, both within and beyond the school site (see Buxton, 2005, for a detailed discussion of data collection and analysis). Data for the present analysis come primarily from ethnographic field notes recorded during 38 visits (averaging 2 hours/visit) to the school. Additional classroom-level data included teacher and student work from several classrooms. School-level data, such as student and teacher demographic data, were collected from district and school Web sites. Two school-produced promotional videos provided visual representations that augmented, supported, redirected, and sometimes challenged the written field notes. Finally, 1-hour ethnographic interviews were conducted with eight members of the CSM community.

Our work combines ethnographic analysis from a sociolinguistic perspective (Spradley, 1980) with theoretical ideas borrowed from Gee (1999). In the initial study, Buxton (2005) conducted a macrolevel ethnographic analysis using Spradley's (1980) three-stage model: a domain analysis focusing on nine categories of sociolinguistic relationships, a taxonomic analysis to link and organize the sociolinguistic domains, and a componential analysis to highlight dimensions of contrast across demographic variables within each domain.

Buxton's first study indicated that students and teachers frequently had different meanings of learning, achievement, resistance, and success. In this study we examined more closely reasons for these differences and mechanisms for bringing different meanings closer together. At this point, Gee's (1999) analytic lens of Discourse was helpful. Drawing on the work of sociologists and anthropologists of science (e.g., Latour, 1987; Traweek, 1988), Gee argued that a scientist's knowledge is not in her head, but is distributed among and/or inscribed in tools, inscriptions, books, journals, bodies, and distinctive practices. Characteristic ways of engaging in scientific practice constitute a Discourse. With this understanding of the distributed nature of knowledge, we read and re-read the entire corpus of data to look for rich points (Agar, 1996) that represented well the Discourses.

We tentatively labeled these rich points as possible boundary spanners, and then examined other temporally close data from across data sets to identify evidence of this possible boundary spanner representing, mediating, shaping, and/or being shaped by student and school Discourses. Data analysis and writing evolved iteratively as we looked for supportive and disconfirming evidence of our interpretations of the boundary spanners' roles.

Results

We identified three types of boundary spanners that mediated student and CSM Discourses and their cultural models of good student identity, student work, and summer work experiences. Here, three cases of boundary spanners at work in these capacities are presented.

Boundary Media and Good Student Identity

One example of boundary media came from two CSM recruitment videos, one produced in 1994 and an updated version produced in 2003. These videos allowed us to access the CSM Discourse, as they were a primary way the school presented itself to the public, were key communicative links between the school and external constituents (such as potential students and financial contributors), and showcased the school's priorities. In the following section, the cultural models of "good student" implicit in the videos is analyzed, juxtaposing the CSM and student Discourses. The ways videos spanned boundaries by promoting student reflection about their own meanings of good student is demonstrated.

CSM Discourse and good student identity. These videos, shown to eighth-grade students throughout the city as part of the school's recruitment endeavors, were designed to give students an idea of the kind of student CSM wanted to recruit and cultivate. They also highlighted the kinds of mathematics, science, and technology experiences students might have at the school (fieldtrips, hands-on activities, challenging work, the development of knowledge useful to their successful futures).

As well, the videos showcased camaraderie among students, faculty support of students, and the potential for networking with successful African American professionals in the city. The CSM Discourse did not differentiate between "good student" and "good science and mathematics student." Although this distinction might seem important from an outsider perspective, as members of a community focused exclusively on teaching science and mathematics, the CSM faculty members generally conflated these two ideas. As a 10th-grade science teacher commented, "If we can teach them to excel in science and mathematics, that [sic] other [academic] pieces will fall into place" (field notes, 1/19/01).

CSM's cultural model, or "storyline," of good student went something like this: Students at CSM may not be gifted academically and, in some cases, might even be considered "at-risk" (1994 video). However, they are determined to "give [their] education a chance" (2003 video), are motivated to learn, have lots of potential, and are particularly interested in mathematics and science. Once at CSM, they "gain maturity" (1994 video) and confidence. Teachers at the school "push [students]… as far as [they] can go" (2003 video). Students must learn to work hard, but the rewards are many. They leave the school with more "confidence" (1994 and 2003 videos), "competence" (1994 and 2003 videos), and "earned self-esteem" (1994 video).

The CSM Discourse positioned students as people with potential and a productive future. The school's cultural model of good student was distinct from that of most other public high schools in the city that tended to have lower expectations for students. The school's cofounder explained that teachers hired from within the school system tended not to fare well at CSM:

> One of the reasons is I think they're too sympathetic to the plight of students. They know these students are terribly in need of reports of success, that what they're doing is all right. One of our teachers was criticized by [another], saying "She passes them on to me and they don't know anything." And the Algebra I teacher said, "Well, you know these kids are from the ghetto," and all that. And so I think that's the policy that probably goes on in the regular schools… to give these kids some pride, they let them go on. (Interview, 9/11/00)

As students came from other public schools in the city, their cultural models of "good student" had to be adjusted to be successful at CSM.

Teacher 1:   Well, the sophomores and juniors have had a year or two to get used to the expectations. The freshmen need to be convinced to do what's good for them.

Teacher 2:   They need to be manipulated, really…

Principal: Finesse is how I think about it. The freshmen teachers need to use a lot of finesse. (fieldnotes, 2/7/00)

Student Discourse and good student identity. In contrast to the school's cultural model of good student, the students' cultural model of good student went something like this: A good student does not fight or talk trash, behaves, shows up for class, and follows directions. Good behavior is a fair exchange for not being pushed by a teacher to work too hard. Thus, the gap between cultural models of "good student" held by the students and held by the school was quite vast. (See Buxton, 2005, for ways students negotiated different cultural models of learning, achievement, and success between their home school and CSM.) The videos, as boundary spanners, made CSM's cultural model explicit, providing incoming students with the first of many conversations about how to succeed and achieve at CSM and in life—"It's a good place if you want to come and start to really figure out… what you want to do with your life" (Teacher in the 2003 video).

The videos made explicit the good student cultural model for potential students, many of whom experienced a significantly different cultural model of good student in their prior schooling. Our analysis of these boundary media in affecting student Discourse stems

from a sociocultural view of learning, based on an assumption that people grow and learn in the images of identities they find attractive or interesting (Brickhouse, 2001; Carlone, 2004; Eisenhart & Finkel, 1998). In presenting a compelling alternative "storyline" about what it meant to be a student, the videos put forth a believable and achievable Discourse that attracted students.

Although these examples demonstrate how boundary spanners represent and help make meaning of a Discourse, our framework also assumes that boundary spanners do not simply represent a Discourse—they, too, are fluid and get shaped over time by other Discourses.

In comparing the two videos, we noted some interesting shifts in the representation of CSM. First, by examining the video images alone, we noticed a drastic change in presentation. The first video was more "romantic" (Principal's description, fieldnotes, 3/14/00), using violin-based music in the introduction and conclusion, showing inspiring vignettes from African American youth for whom CSM had played a key role in turning their lives around. It appealed to a sense of social justice, quoting dismal statistics in the introduction about the city's, region's, and state's poor mathematics and science achievement, then showing visuals of mostly African American students winning academic awards, working intently on problems, and actively participating in class. The second video also served up an inspirational tone, but did so through slick, intricate, and staged photo shots, reminiscent of a pop music video. The introductory music set a more "fun" tone, with a fast-paced tempo.

Although both videos presented similar messages about "good student," only one explicit reference was made to "fun" in the first video's transcript, but three such references were made in the second video. The first video referenced teachers (as "pioneers") only once; the second referenced teachers (as knowledgeable, dedicated, nurturing) 15 times. Most of these 15 quotes came from interviews with CSM students. The second video, visually and verbally, emphasized the "fun" aspects of CSM and the relationships students might develop with caring adults.

To a point, the videos served as effective boundary spanners. First, they highlighted CSM Discourse and made the cultural model of "good student" explicit for various constituencies. Second, they served as key communicative links between the school and the students. Evidence of this link may be seen in the ways the videos' messages evolved in response to student Discourse. However, there is no evidence that the videos shaped students' cultural models of good student. In the next section, a boundary spanner is described that did effectively shape student Discourse.

Boundary Objects and Good Student Work

Our analysis identified a number of "boundary objects" that helped make explicit the student or CSM Discourse, and either helped shape those Discourses, or helped bring them together. Simply making a Discourse more explicit was not, in and of itself, sufficient for us to count an artifact as a boundary object. The object had to cause at least one of the Discourses to move in some way. Boundary objects seemed particularly prevalent in the negotiation of different cultural models of "good student work." CSM teachers often looked for concrete ways to enroll students into a cultural model of good student work with which many were unfamiliar.

CSM Discourse and good student work. An overarching CSM goal was to get students to produce "good work" with "academic rigor." Since students came to CSM with varying cultural models of good work, there was a need for using boundary spanners to bridge differences.

Principal: Well, one thing we always struggle with is the question of whether there is real rigor in our curriculum…Sometimes we really feel that there isn't enough rigor in the curriculum, but at the same time, we lose students because they feel that it's too rigorous.

Dean: They're just not used to it. The expectations are so different from those of their home high schools.

Principal: Right. There, they get A's just by being there and not causing trouble. We have so few problem kids here…

Dean: We need to think about coherent and consistent ways to make our students aware of our expectations, what good student work looks like. (fieldnotes, 1/20/00)

This faculty concern highlights the need for boundary objects to bring these Discourses together.

The following excerpt illustrates one teacher's attempt to create such a boundary object (a model student notebook) for CSM freshmen:

The freshmen struggle at least in part because they really are unclear with what good work looks like. Is it clear? Is it complete? Have you provided evidence? Have you edited your work? On and on. Some teachers think our kids are being lazy because they keep asking, "Is this good enough?" But it's because for many of them, they really don't know. So that's why I gave them the new detailed

notebook model. We'll see if it helps. (field notes; Mr. O'Malley; 4/26/01)

CSM's cultural model of good student work went something like this: Students' work should be "organized," "clear and complete," "evidence-based," "turned in on time," and the "responsibility of each individual." Students should be able to "differentiate between examples of good and bad responses" and should be able to "evaluate their own work based on these criteria." Good work will not only help students achieve good grades and get their schoolwork organized, but will "also help organize their thinking," and will eventually help them "figure out how to organize better other aspects of their lives (quotes taken from observations of Mr. O'Malley's and Mr. Davis' classes). Thus, the CSM goal of getting students to adopt a new cultural model of good student work went well beyond the purpose of promoting achievement in one class. It stemmed from a larger commitment to make explicit the norms of success for life outside of CSM. Mr. O'Malley's explicit notebook model was an attempt to create a concrete starting point for his students to begin to adopt this cultural model. In contrast to this model of good student work, the students' cultural models were much more vague.

Student Discourse and good student work. Significantly, students' cultural models of good student work lacked specificity and tended to conflate "good student work" and "good student." The cultural model went something like this: Good student work is the work done by good students. It involves doing "what it takes to get an A" and this can "be real different between one teacher and the next." In some teachers' classes it means "turning everything in on time," in others it means "just not clowning," and in others it means "taking your notes in the right section of your notebook and knowing how to figure your grade" (quotes taken from observations of Mr. O'Malley's, Mr. Davis', and Ms. Petersen's classes). For example:

Mr. O'Malley: I'll give you some more time tomorrow [to finish the 1st quarter exam] …

Tamika: If I get an A on this exam can I get an A for the quarter?

Mr. O'Malley: Should I be the one telling you that or should you be the one telling me?

Tamika: I should be telling you.

Mr. O'Malley: That's right. That's why I give you the grade sheets every week and why I make time in class every Friday for you to fill them out and average them together and why you have the scoring sheet for all the parts of the final, right?

Tamika: Right.

Mr. O'Malley: So for homework I want you to figure out for me what grade you would need to get on the final, averaging all the parts together in order to get an A for the quarter…

Mr. O'Malley (to researcher): Sometimes I wonder if this [notebook model] is making any difference…. We have them so conditioned that grading is something totally beyond their control, something mystical that their teachers do, that it's hard to change that mindset. (field notes; 10/17/01)

Mr. O'Malley's notebook model as a cultural practice emerged due to his mounting frustration with what he perceived to be incoming freshmen's fundamental lack of understanding of CSM's cultural model of "good student work." As a result, he tried to create more and more explicit and concrete representations of good work. Despite his continued dissatisfaction as he failed to see substantive shifts in students' cultural models in the short term, our data indicate evidence of this shift for some students, especially upperclassmen and graduates. The following excerpt comes from two senior students in Mr. Andersen's physics class.

S1: Mr. Andersen! If I don't turn in this lab can I still make an "A" for the quarter if I get an A on the exam?

S2: Where do you think you are, back in Mr. O'Malley's class? Figure it out for yourself, doofus! (field notes; 3/21/02)

The final excerpt comes from a letter on the "Inspiring Graduates" bulletin board, a place where CSM graduates write letters of advice and encouragement to current students. The letters are complete with pictures of the graduates and generally discuss how the experience of working hard at CSM had prepared them for the rigors of college.

If I could give one word of advice to students that are there at CSM now it would be to learn how to get organized. Teachers there at school always make a big deal about being organized and keeping track of your things. I didn't know it then, but I think that's the most important thing that I learned at CSM…. (field notes copied from bulletin board; 3/14/00)

Both the CSM and the student Discourses of good student work shifted over time in ways that led to increasing Discourse overlap. Mr. O'Malley gradually moved to more and more explicit statements of a particular cultural model that he hoped would reach the students. His notebook model indicates a shift in CSM Discourse toward a cultural model that students might view as better

meeting their needs. Student Discourse, such as that expressed in the physics class and the graduate's letter, illustrates shifts in students' Discourse, demonstrating how boundary objects such as the model notebook model may foster increased overlap of Discourses.

Boundary Programs and Good Summer Experiences

Certain CSM programs brought to the foreground and, in some cases, mediated distinct Discourses, thus serving as *boundary programs*. Several of these programs negotiated the goals of CSM with those of the students. This negotiation is best seen in examining cultural models of "good summer experiences."

CSM Discourse and good summer experiences. CSM touted student experiences that went well beyond traditional schooling, extending into the world of work. One of the school's founding teachers explained,

> One of the original plans was to have all the students complete an internship during their junior or senior year so that they could get the experience of being in a professional science- or mathematics-related work environment….Well, for a variety of reasons, that plan, on a school-wide level, didn't work out, but we have still tried to find voluntary internship opportunities for the students who are interested. (Interview with Mr. Jones, 9/30/00)

The dean of students also alluded to these optional lab internships, commenting,

> There are some summer internships that we facilitate like getting students placed in labs. So Maggie J., for example, had been working in a lab at [the] medical school for a couple of years. We've also had students work in labs at the US Department of Agriculture. (Interview, 5/31/00)

These experiences, as boundary spanners, provide valuable links to outsiders (potential employers gain access to a locally trained workforce) that may stimulate reflection about CSM's educational experiences, serving the needs of students (professional preparation), teachers (better prepared students with a more concrete purpose for learning), and the school (as a public relations tool). Hence, the CSM cultural model of good summer experiences went something like this: "These are kids that got poor science courses in elementary and middle school," but this background can be overcome by CSM's academic training. "Spending four years at CSM will prepare students to succeed in college coursework." Succeeding beyond college means more than just learning to do well in school, but also learning how to engage in the professional world beyond school. Many CSM students lack direct experiences and role models to succeed professionally. "There are no scientific people in their families." "Somebody may be a nurse, somebody may be an X-ray technician…but [science is] probably not talked about a great deal at home." CSM can help fill these needs through summer internships. Thus, summer is a time to "strengthen students' resumes…and provide [them] confidence and competence." These opportunities can "play a pivotal role in providing students with a way out of their economically disadvantaged social situation." (Quotes in this paragraph taken from interviews with two teachers, school principal and school co-founder.)

One such summer experience was a volunteer research assistant program at a university marine science research station. CSM faculty members used a grant to pay the participation fee to encourage applications. One teacher commented, "We know a lot of our students' families don't have extra money to send them to summer programs, so we felt that covering the costs might make it possible for some students to participate who otherwise could not" (field notes; 2/2/02). The promotional material for this summer program emphasized three features: (a) the opportunity to engage in scientific inquiry through "studying coastal estuaries using scientific skills: observation, inquiry, experimentation, data collection and analysis," (b) the development of ecological stewardship "through awareness of connections between actions and consequences," and (c) better understanding of careers in marine science through "assisting on a research project working with marine professionals from a variety of disciplines."

This potential boundary spanner surfaced issues important to CSM about a "good summer experience" (keep connected to science and mathematics, gain an understanding of science-related careers and professional work environments). CSM faculty members also recognized at least one aspect of students' cultural model of "good summer experience" (i.e., it doesn't cost money). However, the summer research opportunity did not align closely enough with students' cultural models to allow for increasing overlap of the Discourses about good summer experiences.

Student Discourse and good summer experiences. Although the school Discourse about summer activities underscored the need to gain new experiences, the prevailing student Discourse about summer activities stressed the need to escape the rigors of school and do things either for income or fun. For instance:

S1:   [looking at the bulletin board promoting the marine research opportunity] They… think

I'm going to spend three weeks down there working for free!

S2: She said it would help you get a good job later.

S1: S—! I need a good job now... I guess I'll go back working at Popeye's again.

S2: That other one – the fixing computers one. Now that sounded okay. But I didn't take that course yet. Maybe I'll take it next year. (field notes; 3/21/02)

Marcus: Oh, I tell you I can't wait 'til this [school year] is over. I'm going to just live on the basketball court...

Jesse: I know! I don't want to see no lab coats and no beakers 'til next year. (field notes; 5/31/00)

Thus, most available boundary programs failed to bridge CSM and student cultural models of "good summer experiences." One boundary program more successfully bridged these models. This program allowed appropriately trained students to participate in a paid summer internship repairing computers at other district schools. According to a teacher,

We work on computers, hardware repair. We have a lot of fun. In the summer time, I take a small group of students to area schools and work on their computers. The kids get paid and it's like a job for them. They get some experience working...on machines, and it's technical experience. (2003 promotional video).

One student said,

Getting paid decent money, $150 a week, to mess around with busted computers. That's all right. It beats flippin' burgers or bussin' tables. It feels good when you can take a machine that isn't working, figure out what's wrong and put in a new hard drive, put in a new power supply, and bingo, its working again! (student, field notes, 9/18/00)

This example shows a boundary spanner that shaped and brought together Discourses. For students, a good summer experience involved a break from academic pressures, a way to make money, and the pursuit of enjoyable pastimes. Thus, the computer technician internship points to a "good summer experience" that largely aligned with both student and CSM storylines.

Discussion

The study of urban educational contexts is largely a study of difference – cultural differences, economic differences, linguistic differences, racial, ethnic and national differences come together in an often-uneasy détente within contemporary urban school settings. The benefits include the dynamism, cultural innovation, and enhanced respect for difference that often develops with the right support. If urban youth are viewed as a potential positive force for social change, then identifying and enacting the "right" supports become primary challenges for those involved in urban education.

Urban educators must find better ways of understanding and bridging the various cultural meanings of schooling, science, and student that circulate within and across different groups. Our research attempts to identify focal points for bringing people and ideas together. We conceptualize such focal points as boundary spanners, which serve as: (a) a bridge for bringing distinct Discourses together, (b) a change agent for gradually reshaping Discourses, and (c) a cultural guide to make Discourses of the "Other" more explicit and accessible across cultural, linguistic, economic and educational boundaries. Hence, the power of the boundary spanner as a heuristic tool is its potential for enhancing theoretical understanding *and* enabling practical applications.

Our work with the boundary spanner concept has raised several challenging issues. First, we faced the analytical struggle of clarifying what counts as a boundary spanner. For example, must a boundary spanner bring together some aspect of school and student Discourse to "count"? We conclude that as long as the boundary spanner helps modify a Discourse, whether or not there is apparent increase in overlap between school and student Discourse, then the object, experience, or media serves as a boundary spanner. One might question, then, whether nearly everything that teachers and students say, do, and produce acts as boundary spanners. We believe the construct is more limited. Participating in a big "D" Discourse requires that what is said, done, and produced must occur in the right places, at the right times, and in the right ways (Gee, 1999). Modifying a Discourse requires participants to modify what they say, do, and produce. Although potential boundary spanners may be abundant in every classroom, enactments that modify Discourse are rarely realized.

Second, we are keenly aware that our analysis of the student Discourse at CSM at times oscillates between deficit and antideficit perspectives. Although our analysis may seem contradictory, the boundary spanner concept requires that we recognize the strengths and positive experiences that urban students bring to school while also pointing to the gaps in academic preparation that teachers must accurately identify and help students

master. In the present study the CSM Discourse was, indeed, less porous than was the student Discourse and, in general, the boundary spanners we described more effectively represented the CSM Discourse. As we work with the boundary spanner concept in other settings, we should better attend to the subtle ways that student Discourses shape school Discourses.

Third, we questioned whether boundary spanners are purposeful or emergent. That is, were the media, objects, and experiences preselected by the CSM teachers to help them and their students come to shared understandings? Or did we, as researchers with the advantage of hindsight, identify instances when distinct Discourses were brought more into alignment and then work backwards to identify the mechanism of this alignment? We feel that boundary spanners are both purposeful and emergent. In this study, they tended to be purposeful in that they were created from the school Discourse to help students better understand and adopt that Discourse. The recruitment videos, Mr. O'Malley's notebook model, and the summer research experiences were explicitly designed to enculturate CSM students into the school Discourse. These boundary spanners were also emergent in that the student Discourse pushed back in ways unforeseen by teachers and helped alter the school Discourse. The evolution of the recruitment videos, Mr. O'Malley's increasingly explicit guidance, and the growth of the summer computer internship are all emergent aspects of boundary spanners.

Teachers who wish to use boundary spanners to increase the overlap of school and student Discourses should recognize and capitalize on the emergent and purposeful qualities of boundary spanners. The boundary spanners in this study were *purposefully* created from an initial desire to move students closer to the school Discourse with the *emergent* result of a shifting school Discourse. In each example, students were the targets of change. In taking our heuristic further, we envision the need to intentionally create boundary spanners to educate teachers and researchers about student Discourse. This is where truer transformative potential lies. Discourses of school science might then become explicit and deliberate targets of change.

Implications for Urban Science Educators

Objects, experiences, and media that may serve as boundary spanners are already in use in many school settings. Their potential, however, often goes unrecognized and untapped because the meanings of these objects, experiences, and media remain implicit. The models that educators provide to students about good

work, for example, do more than just serve as templates for students to achieve good grades—they imply certain cultural models of good student, good work, and the value or purpose of learning science. Educators must seek out opportunities to explore and promote discourse (talk) *about* boundary spanners to affect more powerfully the Discourse (talk, actions, beliefs, behaviors, worldviews) of the participants over time. We need to have conversations with students about our cultural models and what those models stand for, as well as elicit *their* cultural models of good student, good work, and the value of learning science. Boundary spanners, when used in this way, can bring Discourses together.

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