The Structure and Culture of Developing a Mathematics Tutoring Collaborative in an Urban High School

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This conceptual article describes a model of a school-based, student-led initiative that uses peer tutoring to address underachievement in mathematics. The model is three pronged: a) it suggests a site-based approach to building on existing student excellence in mathematics to drive improved student mathematics achievement; b) it seeks to address the lack of teacher knowledge about urban students and their mathematics understanding; and c) it aims to deepen existing mathematics knowledge, confidence and interest among high school students. In the article, I share analyses of the interactions among tutors, tutees, advisors, and teacher; the mathematical discourse within those interactions; and the hierarchical and collaborative relationships that emerged over time.

Introduction

The problem of Black and Latino/a underachievement in mathematics has been extensively documented (Strutchens, Lubienski, McGraw, & Westbrook, 2004; Tate, 1997). Although racial/ethnic gaps in mathematics performance are small in early grades, by secondary school the gap in performance between Blacks and Latino/as, and Asian and White students, has widened. In addition, despite positive attitudes towards mathematics, especially on the part of Black students in secondary school (Strutchens et al, 2005), the performance of these students, on average, does not match their high levels of interest.

Several initiatives seek to address this issue. Various college and university programs have been successful at increasing underserved students' mathematics performance, retention, and participation (Hrabowski, Maton, & Greif, 1998; Fullilove & Treisman, 1990) by working with students who exhibit promise in the latter years of high school or early years of college. Comparable school-based programs in high school, however, are not as well documented. Many of the programs that address the problem of Black and Latino/a underachievement in secondary mathematics are out-of-school, off-site, and/or summer programs. Broad efforts to reform school mathematics (National Council of Teachers of Mathematics, 2000) are promising but do not guarantee or ensure improved achievement for underserved students (Lubienski, 2000; Secada, 1995). Content and/or curriculum based initiatives are also promising for improved mathematics outcomes for Black and Latino/a secondary students, but issues of uniform quality, access and equity often impede their effectiveness (Allexsaht-Snider & Hart, 2001; Darling-Hammond, 2004).

Tackling the problem of Black and Latino/a students' mathematics underachievement in secondary school entails that schools re-consider how they structure mathematics learning opportunities and requires more than enrichment or remediation programs or curricular changes. It is important to provide support for high mathematics performance for all students early, before they are in the latter years of secondary school. Further, addressing the problem of underachievement requires that we consider that students can be positive agents for their own learning and view them as knowledgeable contributors to their own success (Moses & Cobb, 2001). Too much of the discourse about what to do about Latino/as and African Americans and mathematics achievement focuses on those who fail, rather than those who are successful in mathematics. How can schools—even those schools where the average mathematics performance of students is poor—build on the experiences and behaviors of successful students to spur improved mathematics outcomes?

Critically addressing these problems requires that teachers and other school adults rethink their notions of who can do mathematics (Walker, 2003). Many have advocated for critical changes in teacher education programs, saying that they do not adequately prepare teachers to teach in diverse environments, particularly in urban settings where Black and Latino/a students are represented. In these environments, teachers' limited understanding of their students and their negative perceptions and expectations may impede their effectiveness (Groulx, 2001; Jamar & Pitts, 2005). For example, when students demonstrate excellence in mathematics, they may be thwarted by teachers who do not support their learning or give them less challenging work because of their own limited perceptions of African American and Latino/a students' mathematics abilities (Walker, 2003).

Without seriously considering these key issues, school-based interventions designed to improve Black and Latino/a secondary mathematics achievement may be lacking a critical component for success: the belief that competent students engaged in their own mathematics learning can effect improvement in their achievement. In this article I propose a model of a school-based, student-led initiative designed to support mathematics learning, based on my work with students and teachers in a predominantly Black and Latino/a urban high school.

I developed this model in response to participant research I conducted at Lowell High School[1], a small public high school in New York City (Walker, 2006). At its core, the model uses peer tutoring to address underachievement in mathematics. Peer tutoring has been extensively used as a driver for student achievement (for a review, see Robinson, Schofield, and Steers-Wentzell, 2005), but the model described in this article incorporates other participants as integral components for student learning and support. The model is three pronged: it suggests a site-based approach to building on existing student excellence in mathematics present in a local school in an effort to improve student mathematics achievement; it seeks to address the issues of lack of teacher knowledge about urban students and their mathematics understanding; and it aims to develop and deepen mathematics knowledge, confidence and interest among high school students.

The purpose of this article is to share insights about how schools can support mathematics achievement by creating a collaborative space encompassing teachers and students, but where high school students are clearly the leaders, responsible for providing help to their peers struggling with mathematics.

Background

The genesis of the tutoring collaborative occurred during participant research conducted in 2003-2005 at Lowell High School, a predominantly Latino/a and Black school serving about

300 students. At the request of the school's principal, I observed all of the mathematics teachers' classes and conducted two teacher professional development sessions about mathematics attitudes and holding high expectations for students. In addition, all of the teachers at the school were surveyed about their own mathematics attitudes and their perceptions of their students' potential and future success. At the same time, the students at the school were surveyed about their mathematics attitudes, peer groups, and future plans. I was particularly interested in understanding the factors contributing to high achieving students' mathematics success at Lowell. Interviews were conducted with these students, who were identified as high achieving by their teachers, about the networks that supported their mathematics achievement.

When the observations, surveys and interviews were completed, several issues of concern emerged: the predominant use of the traditional mathematics teaching-learning paradigm at Lowell (where teachers lecture about procedures for solving problems and students do individual work on representative problems); the heavy reliance of Lowell's students on their teachers to show them how to do mathematics problems; and the fact that Lowell teachers were unaware of the extent of some high achieving students' collaborative mathematics work, discussions, and problem-solving with friends and classmates. Despite the high achieving students' perspectives, I observed that in mathematics classes, most students seemed to have little confidence in mathematics and when working individually on problems they needed constant verification of their process and reassurance from their teachers. They did not seem to be very self-sufficient, even after the teacher had explained the mathematics content.

Yet it was clear that Lowell's mathematically high achieving students were engaged in networks encompassing fellow students, peers outside of school, and family that supported their mathematics work. Further, these students reported that the fellow students with whom they discussed mathematics work were both struggling and successful in mathematics. When a survey of Lowell's students was completed, however, it showed that they largely had positive or neutral perceptions of mathematics (65% of students) but did not report working very often with others on mathematics problems, studying for math tests, or doing mathematics outside of school (17% of students).

Seeking to build on high achieving students' positive peer relationships around mathematics, to provide a space for both struggling and successful students to develop confidence in doing mathematics together outside of the formal classroom setting, and to help struggling students develop such relationships, I proposed to Lowell's principal that a peer tutoring program be started at Lowell. In mathematics, several authors (Fullilove & Treisman, 1990; Hilliard, 2003; Hrabowski, Maton, & Grief, 1998; Moses & Cobb, 2001) have described the importance of students belonging to peer groups that support their mathematics learning. Making mathematics a collaborative activity rather than an individual one is particularly useful in that learning to communicate mathematical ideas, gaining insight from peers while completing problem-solving activities, and discussing mathematical reasoning, proof, and justification are important components of developing quantitative ability (Hiebert et al., 1997; NCTM, 2000; Webb & Mastergeorge, 2003). Thus, we would invite high achieving students in mathematics to tutor their struggling peers.

In addition, I also wanted to expose Lowell teachers and graduate students in mathematics education to the work and discussions about mathematics in which some Lowell students were already engaged outside of the classroom. The principal was enthusiastic, and we began to recruit teachers and graduate students to participate in the tutoring collaborative and to identify potential tutors.

I recruited several graduate students to work with the high school students during the tutoring sessions as advisors so that the graduate students could have experience in urban schools, as many in the teacher education community suggest (Groulx, 2001; Jordan Irvine, 2003; Rushton, 2004). In addition, the peer tutoring program would provide more opportunities for graduate students to develop meaningful and positive academic relationships with Lowell students, outside of the formal mathematics classroom.

Components of the Collaborative

Tutor Development

The peer tutors in the program were six high-achieving students (five Latino/a and one African-American) who had been selected by their teachers and principal. Three of these tutors participated in an hour-long training seminar in February 2006, facilitated by the author, in which they were asked to solve problems, review high school students' solutions to examination problems in mathematics, and brainstorm tutoring strategies. In addition, as the semester progressed three ninth grade tutors began to work with the collaborative when their teacher invited them to help their peers who seemed shy about working with the older tutors, who were in 11th and 12th grade. These students did not receive training.

Advisor Recruitment

Graduate students in mathematics education, including preservice teacher candidates, volunteered to participate as "advisors" to the high school student tutors for one day each week during the spring semester of 2006. The advisors were told only that they would serve as resources to the high school tutors if they needed help with a mathematics topic. If there were more tutees than the tutors could handle, advisors would help tutor as well. Nine advisors participated in the tutoring program, which took place after school at Lowell during the spring semester.

Session Organization

Tutoring sessions took place after school in one mathematics teacher's classroom three days per week from 3:30 to 5:00 P.M.. Due to a Department of Education requirement, a certified teacher was required to be present at each tutoring session. This teacher, Mr. Tate, attended most of the sessions (and when he was unable to attend, another teacher attended). Tutors and advisors were required to participate in tutoring sessions at least one day per week. Students who sought tutoring would drop in or would be encouraged to come by their teachers. The session content usually focused on students' homework and test preparation. In the first month of the program, tutors worked with an average of 8-10 tutees each week. By the end of the program, an average of 20 tutees attended each week.

In the next section of the article, I describe key issues that emerged from the exploratory study of the tutoring collaborative. I share analyses of the dynamics of the interactions among tutors, tutees, advisors, and teacher[2]; the mathematical discourse within those interactions; and the hierarchical and collaborative relationships that emerged over time. These results reveal that the tutoring collaborative, with its emphasis on student-led tutoring, became a space for doing and teaching mathematics outside of the mathematics classroom that was endorsed by students and teachers at the school.

Characteristics of Tutor-Tutee Interactions

Initially, the tutor-tutee interactions followed the same structure of most mathematics teaching-learning episodes in the United States. Tutors cajoled, disciplined, and admonished tutees about doing their homework, paying attention, and thinking about the mathematics at hand. Tutors generally worked with one student at a time, and asked the supervising teacher, Mr. Tate, or an advisor for assistance if they had difficulty helping a student. Initially echoing the mathematics teaching paradigm in most high schools, tutors explicitly told students the procedure needed to answer a mathematics problem, rarely posed conceptual questions to tutees, and generally had one way of telling the students how to solve a particular problem. The exchange that follows is typical of these early interactions (Field notes, March 8, 2006):

> Rachel: So what's the base?
>
> Christopher writes down the base.
>
> Rachel: You want to start by writing down the formula.
>
> [She writes A = ? bh]
>
> Rachel: So what's b?
>
> Christopher answers her that the base is 8.
>
> Rachel: So fill in b in the [formula].

Christopher writes A = 1/2 bh

= 1/2 (8 * 6.9)

Rachel: So what is 8 * 6.9?

However, as the semester progressed and tutors became more experienced, they began to use different strategies to address students' problems with mathematics. It is unclear how and why they began to use these strategies, although it is possible that the unique opportunities provided by the collaborative discussions of tutors, advisors, and teachers exposed them to new and varied ways of explaining mathematics concepts. One advisor, Clair, noted that,

> He [the tutee] couldn't do 80*4. The tutor didn't tell him to put it in his calculator, she said, 'remember how we did 4 * 8 and then add the zero'. He had a calculator right next to him. She didn't allow him to use the calculator. She kind of reminded him how to do it. (Personal interview, June 1, 2006).

Tutors also used the strategy of providing simpler examples to help students learn mathematics. Although Coco's mathematics terminology is very informal, the excerpt below shows her to be adept at using examples to frame questions so that they can solve problems on their own (Field notes, March 30):

Coco: What's good about this (x^2-4) is it's a perfect square… That's what we call it. Let me give you some more examples of it. Like… well, only when it's negative like x^2-9. So x^2-9 = (x+3)(x-3).

Coco writes down "x^2-36. (x)(x)".

Coco: What would it be?

Barbara: So 6 times 6. x – 6, x + 6

Advisors generally held positive perceptions of tutors' mathematics understanding and rapport with their peers. In addition, advisors noted that the tutors seemed to gain confidence and expertise as the program progressed, for example, Gail noted that,

> [Over time] Rachel became more confident in helping the students and in her own knowledge and in her ability to help other students and…I think she just became more confident in that peer advisor but teacher type role. In the beginning she would work with someone but she was frequently referring to us [the advisors] to make sure she was right or that she was doing the right thing. Near the end, she'd go up on the board and teach to a couple of people or she would sit with a group of people but would not need our help as much. She would not refer back to us. (Personal interview, June 1, 2006)

In the view of the advisors, the tutor-tutee interactions over time became quite different from the standard teaching-learning interactions that occur in mathematics classrooms, particularly in the ways that tutors explained concepts to their tutees. Examining some interactions between tutors and tutees shows the nature of these mathematics discussions.

Mathematics Talk: Examining Tutor-Tutee Discourse

One advisor, Jane, commented that:

> The way Coco explained things was very much, with slang and with like inside jokes and everything. And so they were definitely having more fun than the rest of us, 'cause I was just like trying to explain the math. It was definitely more fun for them and I could see why students would want to come to peer tutoring and not want to come to like teacher tutoring. I mean definitely now as a teacher, I gotta make that work because even though it wasn't so much mathematical language all the time, I mean, it made sense what they were saying, what she [the tutor] was saying, and it was just in a language that the students responded to. (Personal interview, May 30, 2006)

The tutors often contextualized mathematical terms in ways to help their tutees understand. In the exchange below, Coco is trying to help her tutee understand key geometrical definitions and how they are related:

Coco: Bisector, what is that? You need to get bi into your head. You need to know it means two… like bisexual… people dating two… genders… Two equal parts. So these two parts are the same, it can be cutting angles or lines… Bisector… it's bisecting the angle. You just look at it. Why is it an angle bisector?

Stephanie: 'Cause it cuts the angles in half.

Coco: So whenever you see things in two equal parts it's bisector. You got the angle bisector and the median… what's left?

Stephanie: Midsegment

Coco: What's a midsegment? What do you remember about mid?

By and large, the use of informal language by tutors was commented on positively by advisors during the interviews. They admired tutors' strategies and reported that they would adapt the examples, metaphors, and methods of the tutors in their own teaching.

Challenges to Hierarchy: Collaborations among Participants

Initially, tutors only interacted with advisors if they (the tutors) were having difficulty helping tutees. However, as the collaborative continued, tutors also sought help from advisors on their own homework and interacted with them about mathematics in general. On numerous occasions advisors helped to develop peer tutors' knowledge of mathematics. For example, John helped Rachel with her homework (Field notes, March 1, 2006) and showed students (tutor and tutee) how to use the calculator to solve problems with complex numbers (Field notes, March 23, 2006).

Rachel is doing another problem working with exponents. John is looking over her work and confirming with nods or "yeahs."

John encourages her to do another problem ("what else….")

John asks Rachel to consider the meaning of the fractional exponents.

John: Do you know what exponent 1/4 [means]?

It's really the fourth root (he draws the symbol)

That's the coolest thing in math. So if I had $x^{1/12}$…

Rachel draws the radical symbol and writes in the 12 as the index and x as the radicand. (Field notes, March 1, 2006)

Although John is sharing something new about mathematics with Rachel, the nature of the exchange is not that of a more knowledgeable adult "talking down" to a student. John saw the tutoring program as an opportunity to share more mathematics knowledge with students who might not have learned certain related topics or who did not seem to recognize the beauty of mathematics:

Whenever I work with them, whenever I work with students, I would always try to slip in something a little different that may be was a different way of looking at something…[say] you're learning about triangles, this is something else about triangles you might not have known that you might not learn this year, but it's just a little nugget of information. They're always receptive. Also, we would, sometimes near the end of our tutoring, when kids are trying to wind up, we would start with some logic games, or different math games. The kids were interested in it, they enjoyed it. So, it was one of those things, it kinda made math fun. So the kids came in struggling with math but I hope by the end of this, they were really like, 'Hey, math isn't always pocket protectors and protractors.' Maybe they'll want to continue. (Personal interview, June 7, 2006)

John and other advisors who had similar exchanges with tutors and tutees recognize that there are particular codes of mathematics that may interfere with high school students wanting to do mathematics or to show to others, especially peers, that they are capable of doing mathematics (Boaler, 2002; Cobb & Hodge, 2002). In some way, the advisors are trying to break down these codes and be inclusive, rather than using the language and behaviors of mathematics to exclude students. These mathematical interactions served to facilitate relationships between tutors and advisors that were less hierarchical as time progressed. In part this occurred because advisors realized that the ways in which tutors worked with tutees was appropriate and useful in building their own knowledge. In short, the tutors became sites of expertise and knowledge for advisors.

Several advisors noted that seeing how tutors explained problems or concepts to tutees was illustrative. Clair wrote:

> The methods used by the tutors are most likely the methods that are understood better by the students and hopefully, I, in turn, can use them in the classroom. (Personal interview, June 1, 2006)

Clair further noted that

> You don't always have to teach students from a lecturing perspective, you kind of get down to their level and work with them through problems and encourage them to use previous knowledge, problem-solving skills.

While this example reveals a perspective about teaching that is still somewhat hierarchical, it was clear that some advisors developed strong teaching-learning relationships with tutors and tutees over time. On one occasion Ann had a "competition" with one of the tutors:

> She [the tutor] didn't really need to tutor anybody so we had a little competition on the board…It was radicals, simplifying radicals. I think she was talking about it with her teacher that was there. And I said well let's have a competition and I chose some really hard ones and it was good, you know. She beat me once. She's definitely got it. She's got the motivation. It comes kinda natural to her. She enjoys math and I guess being there…It's impressive that she wanted to be there and help people. (Personal interview, June 7, 2006)

The examples mentioned describe a shift in the standard teacher-learner hierarchy. This was not limited to advisors' interactions with tutors and tutees, as the next example will demonstrate.

The classroom teacher present at most of the tutoring sessions, Mr. Tate, had a purely administrative role at the outset—as previously mentioned, the New York City Department of Education requires that students participating in after school activities be supervised by a certified teacher. Initially, Mr. Tate referred tutees to advisors or peer tutors, rarely becoming involved in the actual tutoring. He would also recruit students, standing in the hallways asking "Do you need help in math?" However, as the semester progressed, Mr. Tate, the tutors, and the advisors began to create a more collaborative tutoring space. The vignette below shows an example of the extent to which the tutor, tutee, and Mr. Tate all worked together. The bracketed, italicized text provides some analysis of the vignette by the author (Field notes, April 25, 2006)

> Lori is the tutor working with Alberto. They are doing a homework set, the lesson deals with exponential growth and decay. Mr. Tate is in the room and he is reminding them that if the 'growth factor is lower than 1 then it's not a growth factor anymore, it'll be a decay factor.' Mr. Tate comes closer to them and looks at the book.
>
> Mr. Tate: It's a decay factor because the graph will go lower and lower.
>
> Lori: Oh!
>
> Alberto: And this one?
>
> Lori: That one is easy. Do you see an initial amount?
>
> [*Although Mr. Tate is still present, Lori assumes responsibility for working with Alberto*]
>
> She is trying to help him tie the exponential function in its general form [$y = a * b^x$] with the exercise they are working on, so he can substitute the values and obtain the specific function.
>
> Alberto: One.
>
> Lori: And the growth factor?

They both try to determine what the growth factor is, but seem to have some trouble. Lori calls Mr. Tate and asks him for help. He helps them realize what the factor is very quickly. Still, for the next exercise [$r = 70 * 0.95^x$] they call Mr. Tate again. He begins by asking them what number they have to look at to determine how many places they will move the decimal point. They are analyzing the term, b, that represents the growth/decay factor. The three of them are not quite sure what the factor turns out to be, and they review the lesson in the book in search of hints or similar cases. [*Here the three participants in the exchange—teacher, tutor, and tutee—are all engaged in determining the solution to the problem.*]

Alberto: Oh, we have to do this thing right here, 'cause it's the percent increase. [*The tutee is the one who expresses an approach to the solution first, by suggesting that ".95" has to be expressed somehow in relation to 100%.*]

He looks at his notes and he believes he finds a way to solve it. Lori reads the notes also and begins to understand as well. They go back to the exercise they are working on and try to connect it to the notes, although they can't quite find a way. Mr. Tate leaves them and checks his own book. After some minutes, he comes back and begins to discuss with them what it is they have to do, thinking about the whole process even as he speaks.

Mr. Tate: So it's two decimal places to the left, not to the front, you were right. I wasn't understanding the question before. This still has to do with growth factor.

[*They concluded that in $r = 70 * 0.95^x$ the factor is not 95%, but is a decay factor of 5% (subtracting 100-95).*]

In a similar manner, they talked about 2^x as a growth factor; they multiplied it by 100 to turn it into a percent and saw that this was really 200%, subtracting 100%, they get a growth factor of 100% or 1.

Once they understand this, Lori and Alberto continue working.

The vignette provides an example of problem solving that is very different from the standard teaching-learning interaction that occurs in many classrooms. The teacher and students are working collaboratively on what for them is a puzzling problem. They use problem solving strategies so that they can understand the concepts undergirding the problem, and the teacher and tutor both seem comfortable with expressing that they are not necessarily sure how to proceed. Further, the tutee, Alberto, seems to feel comfortable with their uncertainty. Yet, I would argue that because they have struggled with these concepts together all of the participants now understand better what is going on with exponential growth and decay.

However, on occasion, it was difficult for the teacher to relinquish his standard position as authority and arbiter of mathematics knowledge. In the vignette below, the teacher is called to explain a definition to a tutor-tutee dyad (Field notes, March 8, 2006):

Rachel (the tutor) is confused by the directions. She is unsure what locus means. We (the advisor and the tutor) call over Mr. Tate to explain the questions. Mr. Tate told Christopher (the tutee) that it is 6 points to the left, 6 points to the right, 6 points up, 6 pts down and also diagonally. So it is a circle. Mr. Tate started on the next problem which is to provide a description of all points 3 units from (0,-2).

I interrupted him and said that Rachel now understands and can explain (I saw Rachel trying to jump in when Mr. Tate started explaining the circle).

In this example, the advisor acts on behalf of the tutor when Mr. Tate continues to explain the concept while the tutor is ready to continue working with the student.

In another instance, when Coco, Mr. Tate, and a tutee are trying to identify parts of a triangle, Coco admonishes that the tutee should understand the mathematical terms in her own way (Field notes, March 9, 2006):

> Coco [talking to tutee]: Now remember what bi is. Bi is two. So this doesn't divide into two equal parts. So it's not perpendicular bisector but you thought perpendicular since 90 degrees so that's good…
>
> Mr. Tate: Yeah, it is an altitude. Altitude gives you 90 degrees.
>
> Coco: She should put in her own words and not just copy.

Discussion: Creating a Collaborative Space for Doing Mathematics

The collaborative space that was created by tutors, tutees, advisors, and the teacher over time resulted in productive interactions around mathematics among high school students. The field notes reveal that the room used for the tutoring site served not only as a place for struggling students to get help, but also as a space for teachers to learn from high school students, for successful students to be exposed to additional mathematics, for students to work on homework by themselves, and, on occasion, for students entering the space to become mathematics experts, regardless of their formal status vis à vis the tutoring program. For example, on a day when no tutors came, a tutee who frequently attended sessions, Enrique, served as a tutor for other ninth graders because he had just taken a test that comprised similar problems to the ones the other students were working on. The advisor writes, "At this point Enrique is confident in his work because Mr. Tate just told him he got a good grade on the test he just took" (Field notes, April 11, 2006).

The tutors' confidence in their mathematics and tutoring abilities by the end of the program was apparent—for example, when a student entering the room asked a tutee who to go to for tutoring, Lori immediately interjected, "I'm the best one" (Field notes, March 21, 2006). One of the advisors, commenting about Rachel's growth as a tutor, wrote, "Rachel is so confident. I am shocked. When I first met her she seemed so shy. Today she walked around the room like a teacher" (Field notes, May 24, 2006). Students who were not formally participating in the tutoring program valued their interactions with tutors, occasionally commenting on the skills of their tutors to other students. An advisor described such a day (Field notes, April 4, 2006):

> Today there is another girl in the room who tells Angel that she is a friend of Lori [a peer tutor] and that since they hang out together, her grades have gone up to 90. She encourages him to continue working with Lori.

Although the peer-tutoring eventually began to show elements of integration of and collaboration among tutors, tutees, advisors, and the teacher, a lingering issue did potentially impede the effectiveness of advisors' work with tutors and tutees: their perceptions of urban schools and the students who attend them. Despite evidence to the contrary, three advisors expressed overwhelmingly negative perceptions of students' motivation during interviews conducted at the end of the semester (Walker, in press). Two also expressed, without any evidence at all, that there was a lack of parental interest and investment in Lowell students' education. At least one advisor, despite reporting evidence about positive examples of motivation and diligence on the part of Lowell tutors and tutees, continued to express very negative portrayals of urban students. It may be that more time and more experiences are needed so that negative perceptions and stereotypes are critically examined instead of solidified.

Given some advisors' comments during the post interviews, it is clear that despite their experiences with motivated tutors and tutees, they still equate students' demographic backgrounds as being predictive of students' engagement in school. Without thinking critically about teaching and learning in urban settings and undertaking deeper analysis of the curricular opportunities provided to urban students, it appears that some education students may still be locked into patterns of simplistic thinking about the motivations and interests of urban students. Several advisors made the observation that the mathematics work that students were given at Lowell was not as challenging as it could have been. Jane's and others' observations that "not much is expected or required" of urban students should be a signal to teachers and teacher education students to heighten their expectations of, and requirements of, urban students.

A limitation of this exploratory study is that it does not utilize data on how students performed in mathematics as a result of the participation in the program. Anecdotal evidence provided by tutees, tutors, advisors, and the teacher throughout the program—and after the end of the spring semester—suggests that tutees' grades in mathematics improved. Certainly evidence provided in field notes and by tutors and advisors in interviews suggests that tutors' confidence in mathematics and mathematics tutoring increased as a result of their participation in the collaborative. Further, the advisors revealed that they had learned more about mathematics teaching as a result of participating.

Providing a space for the kind of collaboration that occurred during the Lowell tutoring collaborative was beneficial to those who comprised the effort and suggests that such collaboratives can be positive additions to schools and the learning experience of teachers and students seeking to become teachers. Commenting on the learning interactions that took place, John noted that:

> [i]t was great to see how responsive they were and how eager they were to learn…The people who were there were really receptive and really open to learning new things. And even if I hadn't taught them something different they were excited about it. So I really enjoyed it…I learned a lot just from going and learned how well they could work with each other. And that, I guess, I was most surprised about. (Personal interview, June 7, 2006)

Efforts to address African American and Latino/a underachievement in mathematics should not ignore the talents, skills, dispositions, and behaviors of these students. Too often efforts to improve mathematics achievement, with their emphasis on teacher development and curricular reform, reduce students to unthinking, disinterested bystanders in their own learning. While instructional and curricular issues are critical to address, there are strengths that Latino/a and African American students have that can be used to develop their potential. Initiatives designed to address performance must begin to incorporate these strengths and recruit high achieving and "high interest" students as key agents in improving outcomes for struggling students.

In this study, high achieving high school students provided most of the assistance to their lower achieving peers; however, this article also shows how teachers, graduate students, and high school students can collaborate to develop a community of learners focused on improving mathematics outcomes. The tutoring collaborative described here shows that adolescents can become teachers as well as learners of mathematics; that adults can learn effective instructional strategies from adolescents; and that adults and adolescents can work together to help struggling students outside of traditional authority relationships. A shift in the traditional classroom hierarchy in secondary schools need not be accompanied by a loss of respect for the teacher, but rather such a shift can underscore that the ideas, knowledge, and contributions of all the classroom participants are valued.

The findings from this study suggest that classroom teachers can enhance their practice by, for example, listening to student discourse to gain alternate methods of explaining concepts and allowing students to lead classroom discussions about mathematics problems, solutions, and ideas. In keeping with reform efforts seeking to shift mathematics teaching and learning from a didactic enterprise centered on the teacher to a dynamic interchange between teachers and students (NCTM, 2000), this project demonstrated that collaborative participants modeled ways of interacting that could be illuminating for teacher educators, administrators, teachers, and high school students interested in improving mathematics outcomes. Most importantly, it showed that expertise in doing, learning, and teaching mathematics is not limited to adults who excel in the subject, but that these abilities can be developed in demonstrably powerful ways by high school students—including those students who have been labeled as underachieving and uninterested in mathematics.

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Notes

1 The school name and all names of participants are pseudonyms.

2 Advisors are identified with one syllable pseudonyms, tutors with two syllable pseudonyms, and tutees with three syllable pseudonyms.