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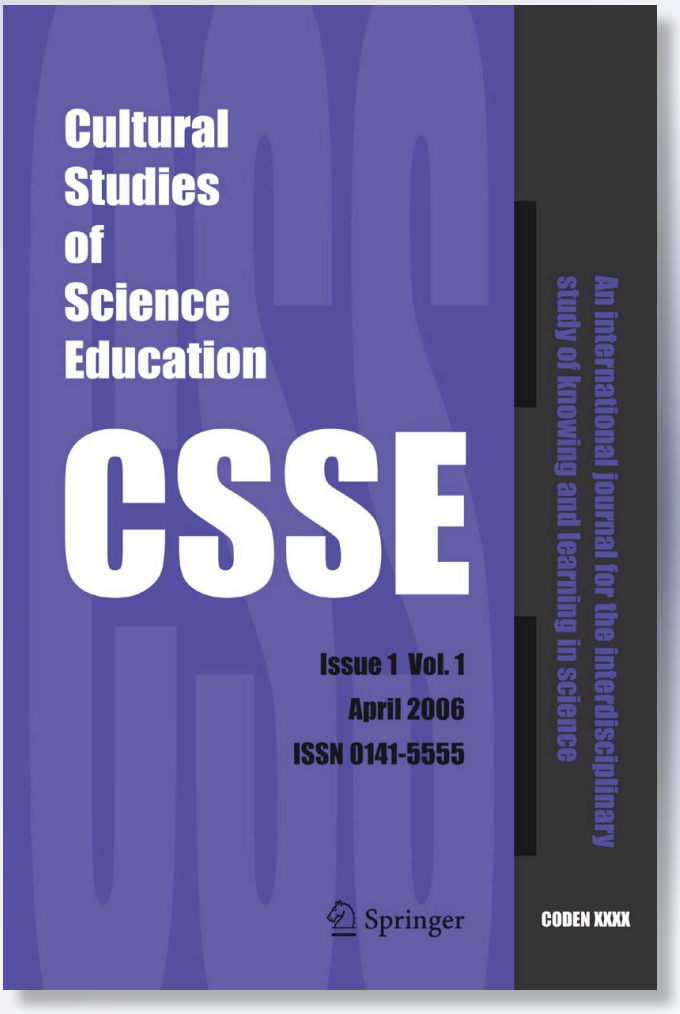

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Learning to teach science in urban schools by becoming a researcher of one's own beginning practice

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Abstract An urgent goal for science teacher educators is to prepare teachers to teach science in meaningful ways to youth from nondominant backgrounds. This preparation is challenging, for it asks teachers to critically examine how their pedagogical practices might adaptively respond to students and to science. It asks, essentially, for new teachers to become researchers of their own beginning practice. This study explores the story of Ben as he coauthored a transformative action research project in an urban middle school as part of a teacher education program and, later, over his first year of teaching at that same school. We describe how Ben and his partner teacher created innovative spaces for science learning. This offered Ben an opportunity to make some of his deeply engrained pedagogical beliefs come alive within a context of distributed expertise, which provided for him a space of moderate risk where he could afford the chances of failure without undermining how he felt about his own capacity as a teacher. Our study highlights the importance of creating reform opportunities within the context of teacher education programs that may help beginner teachers construct positive images of teaching that they can hold on to in their future practice.

Keywords Urban science · Transformative action research · Preservice teachers · Teacher education

Executive Summary (Spanish) Una demanda urgente para los formadores de maestros y profesores de ciencias es la de preparar docentes que puedan enseñar ciencia de modos significativos para los jóvenes de contextos no-dominantes, especialmente de escuelas

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urbanas. Este tipo de formación es desafiante, en tanto va "contra la corriente" de los discursos y prácticas habituales en muchas escuelas urbanas y demanda que los docentes examinen críticamente los modos en que sus estudiantes se involucran en el aprendizaje de la ciencia, piensen acerca de cómo y por qué ese modo de involucrarse difiere de su propio modo de conectarse con la ciencia o del modo sancionado por la escuela en general, y analicen de qué manera adaptar su enseñanza respondiendo tanto a sus estudiantes como a la naturaleza de la disciplina que enseñan. Este desafío implica, en suma, que los docentes nóveles se conviertan en investigadores de su propia práctica principiante. En este trabajo exploramos la trayectoria de Ben, un estudiante de profesorado de ciencias, desde su participación en un programa de formación docente hasta sus primeros años como docente principiante. Analizamos el recorrido de Ben como coautor de un proyecto de investigación-acción transformativa en una escuela media que atiende a una población urbana vulnerable y, más tarde, como docente nóvel en esa misma institución educativa. En nuestro trabajo describimos de qué manera llevar a cabo un proyecto de investigación de este tipo le permitió a Ben, junto con el maestro con quien colaboró, crear espacios de innovación para el aprendizaje de las ciencias dentro del aula. Nuestros resultados muestran que la creación conjunta de estos espacios de innovación fue importante para la formación de Ben porque le ofreció una oportunidad mediada de sacar a la luz algunas de sus creencias pedagógicas más arraigadas en el contexto de un aula urbana real. Participar en un contexto de experticia distribuida le dio a Ben un espacio de riesgo moderado, en el que pudo afrontar las chances de "fallar" sin comprometer su identidad docente. En el proceso de llevar a la práctica las innovaciones planificadas en el marco de su proyecto de investigación-acción transformativa, vimos cómo las creencias pedagógicas de Ben fueron haciéndose más adecuadas a las necesidades del contexto, y cómo su mirada sobre los alumnos fue evolucionando, a medida que fue comenzando a ver a los alumnos como informantes clave de su propia práctica docente y a verse a sí mismo como alguien que tiene cosas importantes para aprender de los estudiantes. Nuestro trabajo, por lo tanto, apunta a los formadores de docentes, en tanto enfatiza la importancia de crear espacios de innovación y reforma en el contexto de los programas de formación docente en ciencias que ayuden a los estudiantes del profesorado y docentes nóveles a vislumbrar escenarios de buena enseñanza sobre los que puedan construir su propia práctica en el futuro.

Preparing science teachers for urban schools

The existence of educational inequalities has been, for decades, a well established part of the educational landscape in many countries, and science education is no exception to that. In the United States, a comparative look at the proficiency in science of 13 year olds from 1970 to present is a compelling indicator of the achievement gap that has persistently existed between minority children in poverty and students from more affluent backgrounds (NCES 2006).

Yet, while research has established that teachers can make a significant difference in closing the achievement gap and ensuring better opportunities for all children (Babu and Mendro 2003), studies also show that there is a severe shortage of effective teachers in schools serving youth in poverty. High poverty urban schools offer children limited access to certified science teachers or to administrators that support high-quality science teaching (Ingersoll 1999) and show a high rate of teacher attrition that leaves schools with a high percent of novice teachers (Ingersoll and Smith 2003). In fact, the current scenario in many

urban schools is what Martin Haberman (1991) has described as "the pedagogy of poverty": a kind of teaching based on a deficit model of urban youth that is reflected in many aspects of the teaching practice (Calabrese Barton 2003). In science, the pedagogy of poverty involves presenting science as a static body of knowledge and focusing on basic behavioral skills rather than supporting students in developing analytic tools or deep understanding. Starting in elementary school, high poverty urban schools focus on teaching basic scientific knowledge and skills, whereas more affluent schools provide children access to richer, problem-based learning and enrichment activities (Oakes 2000).

Preparing good teachers for urban schools serving youth in poverty has, therefore, become an imperative challenge for science teacher educators. According to the National Science Education Standards, a good teacher needs to be able to "offer children opportunities to share the excitement and personal fulfillment that can come from understanding and learning about the natural world", and to develop in students" the capacity to use scientific information to make choices and the ability to engage intelligently in public discourse and debate about issues that involve science and technology" (NRC 1996, p. 1). Yet, as research shows, in order to accomplish those goals and reach all students urban science teachers must develop a vision of teaching for social justice and a holistic understanding of the characteristics of science education in high poverty settings which enable them to enact culturally responsive pedagogical practices that capitalize students' languages and experiences (Calabrese Barton and Upadhyay 2010). As Hogan and Corey (2001) suggest, in science education the process of bridging experiences becomes uniquely important, since teaching science involves enculturating students into a particular way of discourse that takes them beyond the boundaries of their own experiences to become familiar with new explanatory systems, ways of using language and styles of developing knowledge.

However, enacting empowering pedagogies is not only about bridging worlds. It also involves the ability to create learning spaces in science that develop students' abilities to critically reflect on their lives and communities and take action to improve them (Basu and Calabrese Barton 2009). It requires, as well, the capacity to create productive learning environments with students, including negotiating with them classroom rules and expectations to establish a foundation of shared control and responsibility for learning (Tobin 2001).

As Marilyn Cochran-Smith (2004) has pointed out, this pedagogical vision often goes unsanctioned within the typical discourses and practices in most urban schools serving students in poverty. Thus, teacher education programs need to help preservice teachers to develop the vision and tools to work what she has called "both within and around the system" (p. 28).

Transformative action research as a tool for urban science teacher education

Naturally, developing the vision and tools to work both within and around the system in order to enact empowering pedagogies is not an easy endeavor. However, at present, specialized programs for urban teacher preparation are the exception rather than the norm. The most extended approach to urban teacher education includes adding a few courses on multicultural teaching to traditional teacher education programs (Zeichner 2003).

Over the last years, different studies have shown the benefits of offering preservice teachers extended field-based opportunities as a way to authentically interact with their students and become enculturated in the discourses and practices of urban schooling

(Tobin and Roth 2005). This approach to teacher education starts from the assumption that learning to teach is a complex task, configured through the process of becoming a full participant in a sociocultural practice (Lave and Wenger 1991). As learning becomes a process of enculturation, it is not just about what learners know, but also about how what they know is part of a larger system of practices, norms and values (Brickhouse and Potter 2001). In this process, a person's beliefs become crucial to shape the kinds of practices they decide to undertake (Goldberg and Welsh 2009). Constructing a vision on urban schooling that goes beyond naïve (though usually well intentioned) preconceptions requires teachers to revisit, and often challenge, beliefs about what is possible or even desirable in the context of urban teaching (Solomon and Sekayi 2007).

Becoming an urban teacher is also a matter of identity development, since getting involved in new activities, performing new tasks, and mastering new understandings also means becoming a different person with respect to the possibilities enabled by being able to participate differently within a community (Lave 1996). As Sfard and Prusak (2005) have pointed out, in looking at learning to teach as an identity formation process, preservice teachers' actual identities (what they say they are now) are as important as their designated identities (stories believed to have the potential to become a part of one's actual identity). Therefore, stories of what they can be in the future, as well as stories of the kind of teachers they do not want to be, become powerful elements that shape teachers' identities and, thus, their learning to teach process (Wassell 2007).

Within the tradition of field-based experiences, some teacher educators have proposed transformative action research as a model to prepare teachers to analyze the complexities embedded in the context of their own teaching practice and take action to improve it (Briscoe and Wells 2002). Building on the tradition of action research, transformative action research conceptualizes research as a collective reflection on the authentic needs of a particular context and focuses on transforming the context according to those perceived needs (McTaggart 1997).

Research has shown that engaging in transformative action research can support teachers to reflect upon their own beliefs and practice, as well as to collaborate with others to improve their teaching and the learning experiences of their students (Price 2001). Building on those studies, we were interested in analyzing the potential of offering future urban teachers the opportunity to participate in transformative action research as part of their preservice experience.

Research setting

In this study we followed the journey of Ben as a preservice and novice teacher. Ben was selected among other preservice teachers to participate in the Urban Science Education Fellows Program (Furman 2007). This yearlong program was offered within the Master of Arts in Science Education program at Teachers College, Columbia University. Annually, ten preservice teachers were selected as fellows and offered the chance to work for a minimum of 10 h per week at a partner urban middle school. Fellows got a stipend for their participation in the form of university credits. Participant schools were middle schools that had voluntarily partnered with the Urban Science Education Center for the last 5 years in different projects. Within each school, fellows were assigned to work with one partner teacher. Partner teachers were chosen because of their interest in having fellows collaborate in their classrooms. In exchange for their participation in the program, teachers received university credits. Each fellow worked with a doctoral student at the Science

Education Program, who acted as a mentor, meeting with them and their partner teachers in school at least once a week and collaborating with their projects.

At the beginning of the academic year, fellows were asked to visit their partner classroom, meet their collaborating teacher and observe a few lessons. Then, fellows and partner teachers had to take up an investigation based on their own interests and the needs they perceived in the classroom. We refer to these investigations as transformative action research projects because we wanted and expected that in the process of analyzing the questions under investigation, fellows, like Ben, would develop knowledge, tools and resources in support of making change in their own practice and in their classrooms. It was important that the project be collaborative as partner teacher participation was crucial to the projects coming to fruition in the space of their classrooms. However, it was also important that the project be required, in order to provide the reason or the excuse for the fellow to try out new ideas in traditional spaces. As we describe later, Ben's project focused intently on incorporating students place-based experiences in his teaching.

After they selected a question for their research project, fellows and collaborating teachers would design an intervention and ways to collect data. University mentors, usually doctoral students at the Science Education Program (in this case, the first author of this paper), visited the classroom at least once a week and helped teachers and fellows frame their study as a research project, including developing research questions, planning the data collection process and analysis and helping out in general with the study. In addition to being researchers, fellows took other roles, such as assisting partner teachers in developing curriculum and, often, co-teaching. It is important to note that fellows were not student teachers. In fact, the fellowship did not replace the student teaching hours that they had to take in order to graduate.

In crafting his project, Ben, along with his fellow USEFs, were provided with ongoing opportunities for discussion and collective reflection aimed to support them in blending educational theory and practice, such as weekly meetings with other participants in the program. He collaboratively blogged on his projects allowing for asynchronous debate about their projects. He also kept a written journal reflecting on his experiences as he worked at the Science School, and submitted written and oral final reports of their project at the end of the year to the Science School and to us.

We focused on Ben's story because of his strong interest in teaching science at urban schools, where he felt he would be able to make a bigger impact than in more affluent areas. Ben was a 26-year-old Master's student in the program of Science Education with a background in Biology. A European American, he grew up in Oregon, where his parents maintained an organic farm. Before coming to New York City, he conducted research in forest ecology and taught informal science education programs to students living in poverty.

As a preservice teacher, Ben was placed at The Science School, a neighborhood school serving a high-poverty immigrant Latino community. The school had a science focus, with five periods of science each week. He worked with Mr. Menotti, a 6th grade generalist with 5 years of teaching experience, who taught the subject The Living Environment to five sections of general education classes composed of approximately 30 students.

Methodology

Within the tradition of qualitative inquiry, we grounded our study in a case study methodology (Yin 2003) with the goal of understanding in depth the nuances of the complex

process of learning to teach. The qualitative nature of our research required us to use extensive, multiple sources of information in order to provide the in-depth detailed picture of the case that we presented. We used an ethnographic approach to data collection, which involved gathering multiple forms of qualitative data as participant observers within the field for three semesters (two semesters of his last year as a preservice teacher and the first semester of his inservice experience), including weekly classroom observations, lesson plans developed by Ben and his partner teacher, a selection of Ben's collected data and his data analysis that he included in his mid-year report, his weekly entries on his reflective journal and biweekly blog comments, together with his final project presentation and written report. In addition, we conducted three 1-h-long semi-structured interviews where we asked him to describe and reflect on the development of his transformative action research project and his visions of urban schooling as he went through the program as another way to capture his own vision of the learning process he was undertaking.

Data were collected and analyzed using a grounded theory methodology (Strauss and Corbin 1994), which involved approaching the research study with a set of exploratory questions and goals and then developing theories based on the patterns that as researchers we were able to identify. Based on this approach, we started the process of data analysis using an open coding method, reading through the data as we collected it and looking for examples of the learning activities that Ben and Mr. Menotti coauthored in the classroom. As we went deeper into the data analysis, we cut across those examples and looked at how Ben's beliefs and visions had evolved as he engaged in the process. We then looked at the ways the context afforded him those learning opportunities.

Finally, in an effort to build an authentic representation of teacher learning, we invited Ben, who is now in his 4th year of teaching, to join us in co-authoring this manuscript and interviewed him about his experiences and reflections on teaching to non-dominant students 4 years after the program. His primary role as co-author has been to reflect on his past journey and the ways the program contributed to his present practice.

Who creates relevance for the science curriculum? A transformative action research study

In this section we introduce Ben and Mr. Menotti's transformative action research study. Next, we present two vignettes that provide more detail about the kind of teaching scenarios that Ben and Mr. Menotti coauthored as part of their study. Within each vignette, we look at how the experiences shaped Ben's process of becoming an urban teacher. Then, we describe Ben's initial experiences in his first semester as a novice teacher and show how he was able to build on some of his experiences as a fellow.

In looking at Ben's story, we found that engaging in transformative action research as framed by the program that we described can better prepare a new urban teacher to be successful and to sustain their teaching in transformative ways in their teaching career. Cutting across vignettes, we discuss some of the reasons why this approach was successful for Ben in the short and long term.

Program description

Mr. Menotti's sixth graders were studying a unit about farming and food distribution as part of their 6th grade *The Living Environment* curriculum. Over the unit, students performed different activities that mainly involved conducting readings, answering questions

on those readings and, occasionally, conducting experiments on topics such as the needs of plants. Mr. Menotti was a very organized teacher and had set clear classroom routines where all students were asked to participate in the discussion and to be on task.

After his first weeks of work at The Science School, Ben had the impression that Mr. Menotti's students did not find the topics within the unit on farming very interesting. He attributed that lack of interest to the fact that the science content was not presented in ways that were relevant to their lives. This perception came from his initial ideas about what urban students would find relevant. Coming from a rural area, and without knowing any urban children, Ben had the assumption that living in a large city made most children feel disconnected from science and nature, and that the curriculum needed to be adapted to help children understand their connection to nature. As he put it, for urban children "reading about what a farm is like the same as reading about what an atom is like". To Ben, relevancy made something interesting or worthwhile to learn and thus was a critical aspect of learning. However, he pushed this point further, and from his own work as an informal educator he also believed that such relevancy engaged students' minds in ways that would allow them to think through the content in deeper and more consequential ways. He would often claim that students needed to see how and why science was connected to their everyday lives in order to engage in science learning, and stated that urban teachers needed to learn how to help students to make that connection. In an interview he said:

> Urban students don't have that connection to the land and so teachers need to figure out how to make a connection between what they are learning and their lives. Because I feel that if there's no connection, what's the point of them learning it, how is that helping their lives? I think it's just hard for anyone to learn about a subject that has no relevance to them. So I think teachers have to figure out ways to motivate the kids themselves, to show them how science can impact their lives and change their communities. I think it is like, you know, you work in an area, like an urban setting, where the community has a bunch of good things and a lot of things that could be improved, like pollution. What I would do is try to show the kids that 'maybe your river is polluted, what could you do to change that?' and try to show them how the tools of science can be used to improve their community. And so by showing how science can improve their community I think it would motivate them to learn.

When deciding on a topic for their transformative action research project, Ben brought his concern about making science relevant to students. He wondered whether the inclusion of community experiences, which he described as activities that showed how the science topics they were learning in the unit were present in the community, would make the science curriculum more relevant to students. Mr. Menotti also wondered about how to increase his students' interest on the unit topics and found Ben's idea an interesting theme to explore. Thus, it became the focus of their transformative action research study.

Together, they designed the intervention, which went as follows. They would create a set of three community experiences throughout the year and integrate them to the curriculum, as the first vignette presents. Then, they would interview students in focus groups to assess whether their perception of the relevance of the topics had changed, as the second vignette shows. For the interview, they would invite students in the class to volunteer for a group talk about what they found interesting about the unit during lunch-time. Finally, they would analyze the data in order to make conclusions about the value of community experiences in making the curriculum more relevant to students.

Vignette 1: A visit to the local markets

The first community experience involved a field trip to a local grocery store and a greenmarket, where farmers sell produce directly to consumers on the street. Ben and Mr. Menotti planned this activity in order to help students notice how science knowledge could help them make choices when buying food in their neighborhood. They created a worksheet for the field trip that helped students gather different sorts of information, which would be later analyzed in the science classroom as part of the lesson on farming and food distribution.

During the visit, students were asked to compare how produce was grown, distributed, and sold at the two markets. They did so by observing different fruits and vegetables, examining their prices and studying their packages. They also had to record as many places where products came from as they could, and take pictures to share with other students. Students interviewed the produce manager at the grocery store and a farmer at the greenmarket about their work and their products.

Back in the classroom, children discussed their findings regarding the differences they had found between both markets, such as the distance that different produce had travelled to get to each market and the variety and prices of the fruits and vegetables that they offered. Ben and Mr. Menotti guided students to reflect on how their choices when buying food had an impact on the environment. For instance, they had students calculate and compare the amount of fuel that was necessary to transport food in each case.

During the following weeks, Ben and Mr. Menotti designed and conducted a follow up activity: a classroom debate. Students, working in teams, had to argue for two different sides on a discussion panel: organic versus industrial farming. When preparing for the debate, students used their own notes from the market visits, as well as other texts provided by the teacher, in order to think of good arguments to support different roles that they were assigned to play, such as a truck driver or an organic farmer. After the debate, students had to make a written personal decision on what type of food they would choose to buy and provide reasons to support their choice.

The activities that Ben and Mr. Menotti coauthored were transformative both for students and for Ben (and certainly, we believe, for Mr. Menotti as well, although in this study we will focus on Ben's experience).

The debate was transformative for students because, as Ben reflected, most children in each panel were able to present convincing arguments that supported their positions. Some panelists and members of the audience spontaneously began to probe their opponents about the evidence for their reasoning. Several students who had previously showed a very peripheral participation in the science class were fully invested in the discussion. As Ben recalled in his journal, by the end of the debate the discussion had become fervent, with students speaking in their own words and using discussion skills that they often employed outside school:

> When students first began they were basically reading off of their papers, but even when they did this most spoke loudly and made eye contact. About halfway through the debate, though, something happened. The students really figured out what was supposed to happen in a debate. They started asking each other really good questions that challenged the heart of what the different roles stood for. Also, they started getting sassy using their own 'street speak' and they started using body language. It was really cool to see. They were using skills that had already developed outside of school and got to use them for the first time positively in an academic setting.

Ben described the visit to the local markets as transformative because it helped to position students differently in relation to the process of knowledge construction. By having them collect and analyze authentic data from real-life contexts, he thought, students began to take an active role in trying to understand the meaning of different sorts of data when seeking for an answer for a science-related question, such as the ways different forms of farming and food distribution would impact what kinds of options are available for consumers. The follow up debate required students to use the information they had gathered and what they had learned about the topic in order to support a specific position and, later, to make a choice of what kinds of food to buy, and in that way offered a chance to bring to the foreground the ideas that students were forming about the subject matter and put them under debate among the classroom community of learning.

Later, Ben explained how the debate showed students that learning science also involved looking critically at many angles of a problem, seeking evidence from different perspectives and using scientific knowledge to make an informed choice, and developing student analytic and argumentative skills. He believed that the experience provided opportunities for students to see the many ways in which science-related topics were present in their own communities, and interact with science outside the classroom context. Along these lines, he also thought that these opportunities challenged some stereotypes of who is knowledgeable about science related matters. Community members, such as farmers and grocery store managers, for instance, started to become a source of information that children were then able to analyze and incorporate science knowledge that was sanctioned in the science classroom. In this way, the experience was a starting point to make science knowledge more than just what you find in textbooks or the science classroom.

Secondly, the activities were also transformative for Ben, because they allowed him to try out presenting science to students in a novel way, which introduced students to a science-related topic in its complexity, showing its links to technology and society, and thus going against the grain in presenting science as more than a body of facts, which research has revealed as a usual practice in urban classrooms (Oakes 2000). As Ben recalled, knowing about farming, for instance, went beyond understanding the basic needs of plants or the different types of soil and started to include the relationship between food transportation and energy consumption, and recognizing the power of consumers to make food choices and to understand the effects of different kinds of food on people health.

At the same time, Ben came to realize that the community visit and the debate had provided him with new insights as to whom his students were. He was able to see that within the community experiences students interacted differently with the content knowledge and drew upon resources and skills that he had not seen in the science classroom. For instance, he believed that the community experience gave him deeper insight into how extending opportunities for student participation, such as interviewing or taking pictures, could show him what the students found meaningful. He reflected about this on his journal:

> I got to see different strengths the students have that I don't normally see in the classroom, like interpersonal interviewing skills. It will also be interesting to see what kinds of photos the students took to see what they thought was important.

The debate was important for Ben since it showed him that skills that students had built outside the science classroom could be drawn upon in relation to learning science and gave him a new understanding on the importance of drawing upon non traditional forms of capital in his future practice. It also supported him in articulating the idea of how creating

new spaces for learning that capitalized on resources not traditionally considered as pertinent to school had the potential to give him, as a teacher, deeper insights into his students as people while, at the same time, creating a more inclusive science classroom. This idea started to appear in his journal reflections after this activity:

> This is an excellent example of looking at capital in an antideficit perspective. Most of the time, when the students are using these skills they are sassing the teacher or causing trouble among their peers. Having good argumenting skills is not usually seen in a positive light.

As this quote shows, for Ben, some theoretical constructs such as "cultural capital" (Bourdieu 1986) and "antideficit perspective" (Calabrese Barton 2003) that he had learned at his graduate courses started to take shape as he analyzed actual students' responses within the context of the community experiences he developed. It is interesting, for instance, to note how Ben started to see his student's behaviors through a new lens, no longer characterizing certain styles of discourse as examples of "sassing the teacher" or "causing trouble", making his observations part of a bigger theoretical frame that he was building, as a future teacher, to understand his practice.

Vignette 2: Focus groups as spaces for learning from, with and about students

In order to collect data about the impact of the community experiences on students' perception of the curriculum relevance, Ben and Mr. Menotti decided to interview the students in focus groups during their lunch period. Mr. Menotti asked students to volunteer for the conversations and explained children that they were interested in listening to what they had to say about the science unit that they had been studying. Ben expected that students would find the science topics covered in the community experiences more relevant than the ones taught in other types of activities. Both him and Mr. Menotti also wanted to extend the opportunities for students to have voice in what these experiences might look like in the future in order to use that information to plan new activities. Over the Fall and Spring semester Ben and Mr. Menotti conducted four 45-min focus group interviews, with small groups of about six students each. Ben recorded the interviews and later transcribed them verbatim. Afterwards, Ben and Mr. Menotti analyzed the transcripts together, looking for evidence related on how students felt about the relevance of the content before and after the community experience.

Ben described how the focus groups had positioned children as experts of their own learning process and allowed them to teach him and Mr. Menotti about their experiences with science in and outside the school. By giving them epistemic authority (i.e. the authority of being "experts" on their own learning process), he felt, these spaces gave children the chance to reflect on the place of science in their lives. He also recalled that students' responses in the focus groups challenged his initial expectations of the kinds of connections that children would make with the content. At the beginning, he had the assumption that urban students had no connection with science or nature in their lives. Here, we see how his growth as a teacher included becoming more aware of limitations of stereotypes or generalities such as these. He realized that students were not only seeing scientific topics in their everyday lives as he had expected, but also using science to influence other people's choices, such as where to shop or what to buy. In his project report, Ben selected the following focus group excerpt to illustrate this idea:

> [Student:] My grandmother, I went food shopping with her last month and, um, I was reading some macaroni and cheese, the back, I think it came from, um, Virginia or something like that. And I told her, 'look at this macaroni and cheese and all the way it came from' and she said 'oh, um'. I thought it was not regional. And I told her to not buy it because it came from a long way.

Finding that students' connections involved using science to make changes for themselves and others was a new insight for Ben. He had not expected that to happen, or at least, not after a few months of school. As it is the case with many beginner teachers, his surprise shows his lowered expectation of the kind of connections that urban students would be able to make to the content. Yet, listening to students in the focus group helped him start to challenge this assumption. During one of our interviews he reflected:

> I was really surprised with the connections they came up, the things they were doing, the way they were taking things that they learned in science class and really try to make some changes in their lives. It was bigger changes that I expected to hear from them … We decided to only focus on having the students learn how the community works, and I did not attempt to use our planned activities to create change within the community. Interestingly though, as I made the scientific content more connected to the community and students' lives, they began to use their new knowledge to create change for themselves.

During the year, Ben found the focus groups a space to learn from, with and about the students. Perhaps more importantly, students' responses in the focus groups challenged Ben's initial ideas as to who was responsible for creating relevance. As we saw, he learned that students were already able to make connections between science and their lives before participating in the interviews, as other research has shown (Seiler 2001), although he had not been able to "see" them. Ben found that students were able to make even more connections after being asked to actively reflect on the relevance of the curriculum and attributed it to the fact that they had a real venue to share them. He shared this idea with other fellows in the blog discussion:

> One thing that I discovered after several focus group interviews with the students is that the focus group interviews themselves seemed to increase the amount of relevance in the science curriculum. Because the students knew I was going to be asking them how the science curriculum connected to their lives, I believe they started thinking about those connections more.

This finding seemed to have important implications for Ben's views of himself as a teacher, as he began to shift his position from a relevance provider towards a participant in the collective construction of relevance. He started to see that the connections between science and the students' worlds were not just there, waiting to be revealed. On the contrary, those connections were successfully created as students actively tried to find them both by themselves and by engaging in conversations with teachers and other children. This led him to keep conducting focus groups after the unit on farming was over and, as we will see, as a novice teacher, since he found it an important strategy to connect with his students and have their voices inform his teaching practice. This also speaks to the power of Ben appropriating some of the inquiry-based practices that come with becoming a teacher researcher. Here, Ben started to see the value of utilizing research practices with his students, and how this data could inform his teaching, and/or how the students can serve as co-researchers with him to improve teaching and learning.

Ben as a novice teacher

After graduating, Ben applied for a job at The Science School and started to work there. He was assigned to teach five sections of sixth grade, including one bilingual education class. He replaced Mr. Menotti, who moved to a new position as lead teacher. Ben was assigned the same classroom where he had worked as a fellow. Over these first months of teaching, he struggled with learning to navigate the school environment as most beginning teachers do. Especially, he explained, teaching was very difficult in terms of classroom management. He thought of quitting a few times when he felt that he did not have "the skills to deal with the job." In reflecting on his project as a fellow, he shared:

> It is really strange for me to go back to what I was thinking about teaching last year (my big ideas) to what I'm thinking about teaching now (what am I doing tomorrow?).

However, even within the difficult times he was experiencing, some of the practices that he developed as a fellow started to emerge. For instance, he organized a lunch focus group with students in his "worst behaved" class to learn from them about how to teach them better. For the focus group, he invited those students that he felt were "in the middle" in terms of engagement, whom he was afraid of "losing" if the class continued to be chaotic.

He also created a community experience, where he took his students on a field trip to a local park to connect the topic of food webs they were learning about with the organisms they could find in their community. After the field trip, he explained how he was able to "see his students under a new light", as they showed their curiosity and excitement about the natural world in ways that most of them did not express in the classroom.

Four years have passed since Ben finished his fellowship. At present, Ben continues to teach science to low-income middle school children in another state and has become, he believes, a successful teacher:

> I finally feel like I'm a pretty good science teacher. This last year I was just teaching life science to 7th graders so I could put all my energy into making it a really good class. I've got a lot of hands on activities to make things engaging: last week we were using dichotomous keys to identify the aquatic macroinvertebrates in a nearby river and pond.

It is interesting to note how the whole idea of relevance, which was key to his pedagogical thinking as a preservice teacher, continued to evolve. When thinking back on his major concern about making the curriculum relevant for students, Ben reflected:

> Relevance is important but exposing students to totally new ideas is also important. It helps, of course, if you can find a relevant connection, bridging a new idea with something that they already have experience with. At my friend's school, for instance, teachers would notice that students had an interest in a topic (like water) and then they would set up their whole classroom to focus on water like doing lots of things with watercolor, adding water to a sand table, going out and watching it rain, etc. This gave the class many opportunities to focus on science questions and discussions about different water topics. The problem she saw is that students in this setting would never be exposed to completely new ideas that they had never known about at all, so it is the job of the teacher to introduce students to these totally new ideas that may not be at the beginning relevant to them. Next year I'm working on more placed-based education, and inquiry.

Although this quote reflects the evolution of Ben's thought as a beginner teacher, it is also problematic, as it suggests that he reverted, at least in part, to the idea of the teacher as a "relevance provider" and also to the hypothesis that there are certain topics that students have never thought about in their lives. This perspective is, in itself, deficit laden as to the needs for some students to be "educated" by schools about canonical science. Yet, at the same time he sustained in his current practice some of his efforts of gathering "data" from students by creating spaces for open discussion about what they were learning and how they found the curriculum related to their lives and used that to inform his teaching. Therefore, his initial idea on the importance of relevance has become a foundation to build new understandings as he developed his teaching expertise. As such, his vision of relevance continued to become more nuanced in ways that, in a few years allowed him even to question some of his initial assumptions. We see how, for Ben, relevance continues to build upon two lines: opening up new worlds, such as including new topics that, at least in his assumptions, students are not familiar with, and connecting to what is familiar.

What can we learn from Ben's journey?

Cutting across the vignettes, we see how learning to teach science in an urban school is a generative process that entails learning to merge a vision of what is not yet with the pragmatic realities of urban schooling. For Ben, making his deeply engrained beliefs come alive in the context of a real classroom and with the support of his partner teacher, made them become more nuanced and responsive to the context, and his visions of students changed, as he started to see children as key informants of his practice and to see himself as a learner. Seeing his ideas take shape in successful ways also allowed him to construct visions of positive scenarios that he would later hold on to guide his future practice. We take up each one of these ideas below using our case study exemplars to both contextualize and problematize our claims.

First, Ben's learning to teach process was framed around his efforts to make his vision of good science teaching come alive within his partner classroom, as he acted on his pedagogical beliefs in order to coauthor with his partner teacher pedagogies that often go unsanctioned in both urban schools and in preservice settings, as showed in the vignettes. For instance, we saw how Ben and Mr. Menotti were able to make Ben's pedagogical beliefs such as the importance of making the curriculum relevant to students come alive in the context of their transformative action research project and, thus, test them within real school scenarios. In doing so, we saw that he started to reconsider his notion of relevance and who was responsible for creating it, as students' responses in the focus groups challenged his initial assumptions on urban children's lack of connection to science and nature. As we showed in the two vignettes, the experience also supported him in extending his understandings of the ways urban children interacted with science in their everyday lives, and how those connections went way beyond what they had learned in science class. He also started to understand what students found meaningful, as he saw for instance when children started to use their school knowledge to impact on other family members when making food choices, and began to consider that understanding as an important contribution to his teaching. As he said: "I think teachers have to understand that connection clearly, I mean how it's important to their lives. Because if I don't know the reason why it's important to their lives, if they can't find the connection, then they don't know what the purpose of science learning would be". As this quote shows, at the end of the program Ben still relied on his initial assumption that teachers need to know students better in order to

provide more and richer links between the science content and student lives, although he also started to consider other ways of achieving the goal of making the curriculum relevant by creating spaces for students to make those links.

In addition, Ben's belief in supporting students to develop tools for independent thinking on science-related matters came alive as he coauthored the debate on organic versus intensive farming. Ben later drew upon the debate as he reflected on how some forms of student capital that were not typically leveraged in science class, such as the use of non-canonical science language, could be good tools for scientific argumentation and how, as a teacher, he could tap into that capital in the science class. In doing so, he also started to see how using these forms of capital could not only foster their engagement but also support their understanding of complex matters.

This finding becomes significant since, as we have mentioned, research has consistently shown that teachers' beliefs are essential in the ways they approach their practice (Schoenfeld 1998). They shape how they make sense of everyday events and the kinds of learning opportunities they create for their students. Teachers' beliefs are also essential to the kinds of opportunities they create for students (Peressini et al. 2004). Expanding their pedagogical beliefs and making them responsive to the context is an essential learning for all preservice and novice teachers, but especially for those who will teach in urban schools for youth in poverty. When beginner teachers start their practice, they often try to act upon these beliefs in creating instructional practices that align with the images of ideal ways of teaching that they envision. In doing so, they need to learn to negotiate their own visions of teaching, informed by their personal experiences and their preservice preparation, with those promoted by the school setting, which are sometimes incompatible (Zeichner 2003). In doing so, they try to negotiate their actual identity, which involves what they can actually do, with their designated identity (Sfard and Prusak 2005), which represents who they want to be in the future, but is also constructed with images of the kinds of teachers that they do not want to be (Wassell 2007). This negotiation process is difficult for all beginner teachers, but more so for those who start to teach in high poverty urban schools, where novice teachers' beliefs usually conflict when they discover that their images of themselves in practice do not match whom they want to be.

Second, Ben started to reconsider the roles of teachers and students in the science classroom. We believe that the ability to learn from their students is an important characteristic that all preservice teachers need to develop. By listening closely to children, teachers can gain insights into who they are and how they interact and struggle with the subject matter. This, in turn, facilitates them to tailor their instruction towards their students. However, we claim that developing the capacity to learn from students is an essential tool for teachers who are going to work in urban schools who, in the majority of cases, experience a cultural divide with urban youth. Teachers of urban youth need to understand what matters to their students and how they see themselves in relation to science and school knowledge if they want to help students see themselves in connection to the world of science.

Although different efforts to recruit and prepare minority teachers for urban classrooms exist, the current student population of teacher education programs is mainly composed of White, middle-class, female college graduates (Swartz 2003). Since this was the case for our participants, prospective urban teachers need to learn how to reach a population of students that has become increasingly diverse (Ladson-Billings 1999). This learning is difficult, since it involves understanding the cultural frames of reference and points of view of students who basically "live in differential existential words" than theirs (Gay 1993). Our study shows how Ben was able to position himself as a learner and to share with

students epistemic authority for their own learning process, including the ways they found science knowledge meaningful and the kind of learning they got from the activities developed in science class. As we saw, by learning to listen to students, Ben often found his own perspectives challenged. His experiences supported Ben in understanding that the active solicitation of students' perspectives was part of good science pedagogy and that he, even as a novice, had some tools to engage in that pursuit.

Ben shifted the role of teachers as relevance providers when he realized that students were making connections with the content and using scientific knowledge in ways that he had not anticipated. Listening to children helped him become more aware of how important it was for teachers to understand how and why students interacted with science in their lives. Starting to position himself as a learner also supported Ben in understanding the kinds of resources that urban students brought to science learning. He started to see that teachers not only have the responsibility to teach students new knowledge and skills, but also to support children in accessing the resources they already possess so as to channel their resources into science learning. This finding becomes important, since the preservice experience is crucial to helping future urban teachers develop tools and a general disposition to learn from students. As Haberman (1995) argues, a failure to do so will lead novice teachers to perceive "a substantial number, even a majority, of abnormal kids in every classroom" (in Ladson-Billings 1999, p. 232).

We also saw how Ben started to construct spaces of shared authority with students as early as in his first semester of teaching, despite the classroom management challenges that he was facing as a new teacher. We believe this finding is especially important in the context of urban education. As Ingersoll and Smith (2003) has shown, teachers' frustration to effectively "control" students is a key factor that leads to attrition among inexperienced teachers in urban schools. As we mentioned before, the ability to build with students productive environments upon a foundation of shared control and responsibility is an important attribute of good urban teachers (Tobin 2001). Again, constructing this kind of environments is a tough challenge for all teachers, and especially for beginners. Yet, our study shows how preservice teachers can start developing the tools to make this happen.

Third, Ben started to construct images of positive scenarios that shaped his views of what was possible in the context of an urban science classroom. These scenarios, which were based on his own experiences, became visions of what he could accomplish as a future teacher or, as Marilyn Cochran-Smith (2004) has called them, "proofs of possibility" which can guide teachers' journeys towards more progressive scenarios (p. 43). Along these lines, Giroux and McLaren (1986) have suggested that critical educators need to develop "a language of possibility" to guide their practice. Visions of positive scenarios and of themselves as agents of change, therefore, are especially important in helping new teachers find a direction even through the complex task of starting to teach in an urban context, assisting them as they "wrestle with their own doubts and fend off the fatigue of reform" (Cochran-Smith 2004, p. 28).

Our study shows that Ben constructed "proofs of possibility" as he successfully enacted his pedagogical beliefs on science teaching in authentic contexts. For instance, he was able to see himself as somebody who could engage students in complex thinking that, at the same time, tapped into their cultural capital in ways that challenged usual classroom practices. What is perhaps most important about this is that the visions of positive scenarios that he developed were grounded in real experiences. In fact, many novice teachers come to their first teaching job in an urban school with visions of themselves as reformers. Yet, as these naïve visions do not match what they can do as beginners in the complex worlds of urban schools, they become frustrated and disappointed and stop believing in the

possibilities of reform or, worse, start developing deficit views of students and of themselves as teachers (Calabrese Barton 2003).

On the contrary, the visions of positive scenarios that Ben developed built on his naïve beliefs but went beyond them as they became grounded and transformed through authentic experiences, although they were scaffolded by his partner teacher in important ways. In doing so, we claim, these visions became part of a stance towards teaching. As Cochran-Smith (2004) has suggested, a stance is more than a vision, as it is provides a kind of grounding from where to interpret and guide one's practice. For Ben, seeing his deeply engrained beliefs come alive in his partner classroom became evidence of what he might do as an urban science teacher. Since he had never taught in a formal setting before, seeing his beliefs in practice as they were enacted and adapted by his partner teacher gave him evidence of how some of his "crazy' ideas," as Ben called them, could be not only plausible but also successful in terms of fostering student engagement and understanding. This became, for him, a proof of what he could achieve as a teacher when other conditions such as classroom management were met. As he reflected on an interview at the end of the program:

> I have so many ideas of things that I would like to do as a teacher. I have these big projects and other things. I still don't know how to pull that off but just to see how an experienced teacher takes the ideas that I have and implements them is really good for me to see. And hopefully by observing that, by being a part of that it will be easier for me as like a first year teacher to try and do some kind of that.

What makes this reflection especially significant is the fact that, as we saw, Ben started to develop learning spaces for his students that built on the teaching scenarios he had coauthored with Mr. Menotti as part of the design and write up of their transformative action research project as he started to teach in his own classroom.

Looking at the context: implications for urban teacher education

In thinking of the implications of this study for the development of teacher education programs, it is important to analyze the ways in which the context of the program supported Ben's learning to teach process. Along these lines, three characteristics of the context were important. First, the possibility of taking moderate risk; second, coauthoring and reflecting on transformations and, third, participatng in contexts of distributed expertise. We elaborate on each of these conditions next.

The first factor that supported Ben in his learning to teach process was the chance to take moderate risk, as he was able to create new teaching scenarios within a context where stakes for him were not too high. When speaking of moderate risk, we refer to the fact that Mr. Menotti was ultimately responsible for the learning outcomes of his students while they tried out the community experiences and other activities related to their transformative action research study. In this way, Mr. Menotti's classroom provided Ben a space which held a certain degree of authenticity while, at the same time, was also safe for him. In the context of the fellowship, Ben was allowed to fail (meaning, for instance, that students might not show interest in the activities they had planned, or might not understand the content taught) in ways traditional student teachers are not, since the success of the lessons they teach directly impacts the evaluation that teachers and supervisors make of their performance.

As we showed in the vignettes, Ben had to take risks to try out new kinds of discourses and practices that are not usually sanctioned in the context of urban schools such as organizing debates, community visits or student focus groups. Had Ben not been allowed to take any risks, his beliefs and practices might have never come to light and, thus, transformed in the process. Moreover, had he not had the chance to attempt any transformation, such as when he and Mr. Menotti organized the debate or the community visits, which were not a common practice in the school, he might have never been able to build positive scenarios of how some of his ideas could be successful in the context of an urban classroom.

On the other hand, the fact that the stakes for Ben were relatively low afforded him the chance to fail and readjust his beliefs and practices based on his own experiences without damaging his self-image as a teacher. Had stakes been too high for Ben, as is usually the case for beginner teachers in their own classrooms and also, though less so, for student teachers, he might not even have tried to enact any of his beliefs or build innovative spaces for learning. Or, worse, he might have seen his ideas fail and constructed visions of the impossibility of enacting his beliefs in the context of an urban classroom or of his own incapacity as teacher. As Ben succinctly put it, when reflecting on the impact of seeing his ideas in practice in Mr. Menotti's classroom:

> Because if I wouldn't have seen that at all, if I would try that myself as a first year teacher, it might just totally blow up my face. And I would be: 'Forget it'. Or maybe I wouldn't even try it.

It is important to note that not all the activities that Ben and Mr. Menotti planned together succeeded with their students. For instance, when he analyzed the results of his study and compared what children said in focus groups before and after the community visits, Ben was surprised to see that community experiences were not enough to make the curriculum more relevant for students. However, for Ben, this and other "failures" were not construed as such, since he was able to analyze with Mr. Menotti the outcomes of the activities they planned together and discuss possible improvements both with him and within the fellowship community of practice. Four years later, when he looked back at his experience as a fellow, Ben reflected:

> Now I really see the importance of taking moderate risk. This is huge and it is something that needs to be incorporated more into teacher training programs. As a student teacher you are working mostly in the confines of somebody else's space and structure and as first year teacher you don't have the skills to pull off many complex lessons, and my concern is if you don't try creative lessons that could potentially fail as a new teacher you will never develop those lessons later in your career.

Ben's quote points to the importance of offering spaces of moderate risk within the preservice experience. This finding becomes important for the design of teacher education programs. For a new teacher, trying out new ideas in the classroom is generally a "sink or swim" situation, since they are ultimately responsible for what goes on behind their classroom doors. But the conditions for Ben were different; there was not failure per se as much as there were moments for learning. It is worth noting that this did not take away Ben's potential feeling of failure, but still it was not constructed that way in the broader learning community and thus the effects were less devastating as it is usually the case for novice teachers.

Second, coauthoring novel teaching scenarios was possible as Ben took part in contexts of distributed expertise (Brown 1992). The concept of distributed expertise portrays

thinking and practice not as a product of an individual but emerging from the dynamics of a group. In this kind of environment, individual contributions are taken to levels that no participant could have attained separately. Distributed expertise was essential in supporting Ben in his learning to teach process. Although Ben's ideas and resources often became the seed for new discourses and practices, to become enacted they required different types of expertise (such as in teaching, in classroom management, in educational research, etc.) that others had to contribute.

Third, taking part in a context of distributed expertise was key to Ben's learning process as a fellow. There were many others who played a pivotal role in supporting Ben in his learning process. His partner teacher, the school leadership, students, university mentors and other preservice teachers brought different kinds and levels of expertise to the new teaching spaces that Ben coauthored. It must be noted that Ben worked with an experienced teacher who was very comfortable with classroom management and had set clear participation routines for his students. Mr. Menotti also brought curricular knowledge, classroom management techniques and knowledge of the school rules. In fact, the possibility to work with a committed teacher who was open to new ideas and willing to devote time and effort to make them happen cannot be understated when thinking of the implications of this study for teacher education. Had Mr. Menotti not been open to developing the community experiences (which meant, for instance, taking students outside school, organizing field trips, preparing with Ben new material for students to construct their arguments for the debate panel), Ben's chances of seeing some of his ideas come alive in positive scenarios would have constrained significantly. This speaks to the fundamental importance of finding partner teachers willing to open their classrooms to transformations and, at the same time, to contribute their knowledge and experience to make them happen, and it highlights the importance of teacher education programs of making concerted efforts to identify, support, and applaud the work of cooperating teachers who are willing to open their classrooms to others.

The program community, which included other preservice teachers as well as the university mentors and faculty, also contributed different levels of expertise. In discussing their projects with their peers and university faculty in weekly discussions and the blog, Ben was able to collectively critique school practices and envision new alternatives for teaching. Importantly, the program community also supported him in envisioning the classroom as a research site and in developing a social justice discourse that he was able to bear upon within the school context. Reflecting on the experience 4 years later, Ben underlines the importance of having a community of learning for prospective teachers:

> Looking back I really do appreciate the preservice teachership program for allowing me to develop ideas and have a team turn them into a reality and I wish I would have had even more opportunities to try out more things before diving into teaching on my own.

Conclusions

Our study speaks to teacher educators, highlighting the value of offering future teachers the chance of participate in field-based experiences where they are allowed to propose innovations, and the importance of doing so within contexts of distributed expertise that provide the knowledge and skills they haven't developed yet.

We showed that engaging in the process of classroom reform allowed Ben to merge a vision of what is not yet with the pragmatic realities of urban schooling in ways that expanded and strengthen his pedagogical thought as a novice teacher, which he could build upon over his first semester of teaching practice.

The fact that the learning activities that Ben and Mr. Menotti coauthored emerged from Ben's initial concern about making the curriculum relevant for students, one of his deeply engrained beliefs, is fundamental to understanding the significance of our findings. It shows that teacher educators must afford extensive opportunities for preservice teachers to make their pedagogical ideas come alive and facilitate chances to enact their pedagogical beliefs within contexts of moderate risk, where they can try out their ideas in scenarios where failing can be construed as a moment for learning, before exposing them to the high stakes environment of real urban classrooms. This idea becomes especially relevant for the preparation of urban science teachers, since many of them will enter schools where the visions of inquiry-based and culturally relevant science teaching proposed by most preservice programs and endorsed by the National Standards for Science Education (NRC 1996) are sometimes far away from the kind of science teaching that goes on in many urban classrooms.

We saw how acting upon his beliefs in contexts of moderate risk, scaffolded by more experienced others, allowed Ben to construct visions of positive scenarios that would later become "proofs of possibility" in his future career, especially as a novice. We know that beginning teachers hold narratives of practice grounded in their own experiences as learners and as participants in experienced teachers' classrooms (Wassell 2007). Their core beliefs are often based on their personal stories of success rather than on evidence for what constitutes powerful teaching and learning (Sfard and Prusak 2005). Visions on themselves and their own capacity also shape the ways teachers frame and address problems of practice in the moment, and how and why teachers navigate social contexts and institutional frameworks that shape the work of teaching. Visions of positive scenarios and of themselves as agents of change, therefore, are especially important in shaping teacher visions of themselves in ways that help them arrange their resources to effectively navigate the environment of urban schooling.

We have also shown that by actively asking for student opinions and understandings, as he collected data within the context of the focus groups, Ben started to think himself as a learner and consider children as important informants of his teaching practice. We believe that this finding is especially important in the present context of urban science education. As it was the case for our participant, prospective urban teachers need to learn how to teach students who may be different from them in important ways. For any teacher, but especially for those who will teach in urban schools, learning how to bridge the worlds of science with the worlds of urban youth requires the ability to listen to students and understand the ways they interact with science in their everyday lives. In getting to know who his students were, Ben started to construct spaces of shared authority with students, which later became a foundation of his attempts to generate a productive learning environment as he began his own practice. This finding points to the value of facilitating opportunities within the preservice experience to engage in productive conversations with urban children in the form of focus groups, cogenerative dialogs (Tobin and Roth 2005) or others.

Although engaging in a transformative research study became the platform that enabled Ben and Mr. Menotti to plan and enact a transformation in the science classroom than, in turn, was transformative for Ben, it is important to note that engaging in a 1 year study can be a difficult and sometimes frustrating process for preservice teachers. We believe that it

was the possibility to identify a need of the classroom, to design a plan to address that need and to plan a way to collect data to analyze whether the intervention had succeeded what was really essential to Ben's learning process. The implication of this idea for the design of teacher education programs is that it may not be necessary to have teachers participate in long or comprehensive research studies in order to attain the same results that we show in this study. We think that providing opportunities for creating and assessing the result of small interventions in a classroom, which are easier to implement and can be included as part of a regular university course, may achieve similar outcomes.

Finally, in looking at Ben's first semester as an urban science teacher, and analyzing his own reflections 4 years later, it becomes even clearer that teaching in an urban school in ways that afford children meaningful opportunities to learn is not an easy journey. Ben's case shows that this was so even for a teacher who had gone through one whole year of preparation within the school where he would later start to teach. Our findings, therefore, demand us to look closer at how urban teachers are currently being prepared, and put a word of caution to the possibilities of programs that place teachers or university graduates in front of urban classrooms after a short preparation time. In all, this study shows the need for teacher education programs that strongly scaffold perservice and novice teachers' process of learning to teach science in an urban school, or inservice programs for continued support, mentoring and involvement with ongoing research, in ways that allow them to gain teaching expertise while sustaining their potential for innovation, which is very much needed in the current context of urban science education.

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Melina Furman is an associate professor at the School of Education of University of San Andres, in Buenos Aires, Argentina. She got an M.S. in Biological Sciences at the University of Buenos Aires and a Ph.D. in Science Education at Teachers College, Columbia University. She worked under the direction of Angela Calabrese Barton at the Urban Science Education Center of Columbia University until 2006. Her research, conducted both in Argentina and the United States, focuses on the preparation of science teachers for inner-city schools and the implementation of large-scale science programs for underprivileged settings. She has

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Angela Calabrese Barton is a professor in the Department of Teacher Education at Michigan State University. She takes a critical sociocultural perspective to understanding teaching and learning science, and works with teachers, students, and families to use science as both a context and tool for working towards social justice. Her work has been published in the American Education Research Journal, Educational Researcher, Journal of Research in Science Teaching, and Science Education, among other places. She has published several books, such as "Teaching Science for Social Justice" and "Rethinking Scientific Literacy."

Ben Muir currently teaches 7th grade science at Hamlin Middle School in Springfield, Oregon. He received a B.A. in Biology at Lewis and Clark College in Portland, Oregon. After graduating, he was a science camp and outdoor school instructor for the Oregon Museum of Science and Industry. Later he taught after school programs at the Big Ugly Community Center in Harts, West Virginia and summer camps at The Web of Life Ecology Center in Naugatuck, West Virginia. He then received his M.A. in Secondary Science Education from Teachers College, Columbia University, where he worked as a Fellow for the Urban Science Education Center. After graduating, he taught 6th grade science at M.S. 331—The Bronx School of Science Inquiry and Investigation. He then moved back to Oregon and taught 7th grade at Meadowview K-8 School in Eugene.