

COMMUNITY AND CLASSROOM CONTEXTS FOR UNDERSTANDING NATURE AND NATURALLY OCCURRING EVENTS IN RURAL SCHOOLS IN MEXICO

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Abstract. In this study, we develop a portrait of how teachers in two, rural Mexican, multi-age classrooms (grades 1-6) deliberately situate science instruction within the local community and teach social discourse practices to mediate their students' transitions between science, school, and community settings. One important means of social mediation was the teachers' commitment to constructing authentic contexts for instruction. In addition, both teachers facilitated the learning of three sets of social discourse practices that are integral to science teaching and learning: responsibility and autonomy, cross-age interaction and collaboration, and public performance. The social discourse practices that we observed in these classrooms can be seen as potential foundations for engaging in culturally responsive, inquiry-based, science instruction grounded in the ways of learning science that many Mexican immigrant students are likely to have encountered.

Keywords: elementary science, social discourse practices, rural Mexican schools

Dutch

Samenvatting [Translated by Tanja Janssen]

In deze bijdrage schetsen we een beeld van hoe leerkrachten in twee klassen met leerlingen van verschillende leeftijden (leerjaar 1-6), op het platteland in Mexico, welbewust het onderwijs in de natuurwetenschappen inbedden in de plaatselijke gemeenschap, en hoe zij een brug slaan tussen natuurwetenschap, school en gemeenschap door onderwijs te geven in sociale discourse. Een belangrijk middel hiertoe was het streven naar authentieke contexten voor het onderwijs. Bovendien faciliteerden beide docenten het leren van drie 'sets' van sociale discourse praktijken die een integrerend deel uitmaken van onderwijs in de natuurwetenschappen: verantwoordelijkheid en autonomie, interactie en samenwerking tussen leeftijdsgroepen, en openbaar uitvoeren. De sociale praktijken die wij observeerden in de klassen kunnen beschouwd worden als fundamenteel voor deelname aan cultureel reagerend, 'inquiry-based', natuurwetenschappelijk onderwijs. Dit onderwijs is gegrondvest in de manieren waarop veel Mexicaanse immigranten-leerlingen ermee in contact zijn gekomen.

Keywords: natuurwetenschappen in het basisonderwijs, sociale discourse praktijken, Mexicaanse plattelandsscholen

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French

Résumé [Translated by Laurence Pasa]

Dans cette étude, nous décrivons la façon dont deux enseignants de classes multi-niveaux (CP-6^{ème}), en milieu rural au Mexique, placent délibérément l'enseignement des sciences au cœur de la communauté locale et enseignent des pratiques discursives sociales afin d'accompagner les transitions par les élèves de la science, à l'école et au contexte social. Un ressort important de cette médiation sociale était l'engagement des professeurs dans la mise en place de contextes d'enseignement authentiques. En outre, les deux enseignants ont favorisé l'apprentissage de trois ensembles de pratiques discursives sociales en les intégrant à l'enseignement-apprentissage des sciences : la responsabilité et l'autonomie, l'interaction et la coopération inter-âges, et les échanges collectifs. Les pratiques discursives sociales que nous avons observées dans ces classes peuvent être considérées comme les bases potentielles d'un enseignement des sciences culturellement réceptif, basé sur des investigations et fondé sur des manières d'apprendre la science que beaucoup d'étudiants immigrés mexicains sont susceptibles d'avoir rencontré.

Mots-clés: science élémentaire, pratique discursives sociales, écoles mexicaines rurales.

Italian

Abstract [Translated by Manuela Delfino].

In questo studio viene ritratto il modo in cui i docenti in due pluri-classi (alunni di età compresa fra i 6 e i 12 anni) di aree rurali messicane abbiano volutamente collocato l'istruzione scientifica all'interno della comunità locale e insegnino pratiche di discorso sociale con lo scopo di mediare la transizione dei loro studenti tra le scienze, la scuola e gli scenari della comunità. Uno strumento importante di mediazione sociale è stato l'impegno dei docenti nel costruire contesti autentici per l'istruzione. In aggiunta, entrambi i docenti hanno facilitato l'apprendimento di tre tipi di pratiche sociali di discorso da incorporare nell'insegnamento e nell'apprendimento delle scienze: responsabilità e autonomia, interazione e collaborazione tra persone con età diverse, e discorso in pubblico. Le pratiche sociali di discorso che sono state osservate nelle classi possono essere viste come potenziali fondamenta per essere coinvolti in un'istruzione scientifica culturalmente ricettiva e basata sull'indagine, nonché basata sulle modalità di apprendimento della scienza che sono state probabilmente incontrate da molti studenti messicani immigrati.

Parole chiave: scienza a livello elementare, pratiche sociali di discorso, scuole rurali messicane

Polish

Streszczenie [Translated by Elżbieta Awramiuk]

W niniejszym artykule opisujemy, jak nauczyciele w dwóch wiejskich meksykańskich klasach, w których dzieci są w różnym wieku (klasy 1-6), rozmyślnie sytuują nauczanie przedmiotów ścisłych w lokalnej społeczności i uczą form społecznego dyskursu, aby ułatwić swym uczniom powiązanie nauki, szkoły i środowiska społecznego. Jednym z istotnych sposobów społecznej mediacji było nauczycielskie zaangażowanie w konstruowanie autentycznych kontekstów do nauczania. Dodatkowo obaj nauczyciele ułatwiali uczenie się trzech form społecznego dyskursu, które są integralną częścią nauczania przedmiotów ścisłych: odpowiedzialności i autonomiczności, interakcji między dziećmi w różnym wieku oraz publicznych wystąpień. Formy dyskursu społecznego, które obserwowaliśmy w tych klasach, mogą być uznane za potencjalny fundament zaangażowania w kulturalnie wrażliwe, oparte na dociekaniu nauczanie przedmiotów ścisłych powiązane ze sposobami przyswajania wiedzy naukowej, których wielu meksykańskich uczniów imigrantów prawdopodobnie doświadcza.

Słowa-klucze: nauki ścisłe na poziomie elementarnym, formy społecznego dyskursu, wiejskie szkoły meksykańskie

Portuguese

Resumo [Translated by Paulo Feytor Pinto]

Neste estudo, retratamos como professores em duas turmas de mexicanos rurais, com alunos de diferentes idades (1º-6º ano), deliberadamente colocam a educação científica no contexto da comunidade local e ensinam práticas de discurso social como forma de mediação da transição dos seus alunos entre ciência, escola e comunidade. Um importante instrumento de mediação social foi o empenho dos professores em construir contextos de aprendizagem autênticos. Além disso, ambos os professores facilitaram a aprendizagem de três conjuntos de práticas de discurso social que são parte integrante do ensino e aprendizagem das ciências: responsabilidade e autonomia, colaboração e interação intergeracional, e desempenho público. As práticas de discurso social que observamos nestas turmas podem ser encaradas

como potenciais alicerces de uma educação científica baseada na experimentação e culturalmente enquadrada nos modos de aprendizagem científica com que é provável que muitos alunos mexicanos imigrados tenham tido contacto.

Palavras-chave: ciência elementar, práticas de discurso social, escolas rurais mexicanas
Spanish

1. INTRODUCTION

There exists a particular urgency in the field of science education to upgrade and intensify our understanding of science teaching and learning with Latino populations in the U.S.A. where they are the most rapidly growing part of the school age population (Rodriguez, 2001: 329-330):

Many students – especially Latino children – continue to drop out (or are pushed out) of school at an alarming rate. We have seen improvement in the dropout rates of U.S. African and Anglo students, but the dropout rate of Latinos/as has ... consistently remained between 30 and 35 percent for over two decades (Secada et. al, 1998; McMillen, 1994)! In the meantime, demographic projects indicate that Latinos/as will be the second largest ethnic group in the U.S. by the year 2010 (Day, 1993; Secada et. al). We are heading toward a social and economic crisis if we do not address the current trend of low achievement and participation of the fastest growing ethnic group in the country.

While the urgency to increase success for Latino and immigrant students in subjects such as science has intensified over the years, it is not new. For over two decades, researchers have been asserting that we continue to be ineffective in responding to this rapidly increasing proportion of our school population (e.g., Amodeo & Brown, 1986; Cortes, 1984; Macias, 1990).

In the current era of reform in science teaching and learning, educators are called to a standard of equity and excellence. “Science for all” is a prominent guiding principle: “Science in our schools must be for all students: All students, regardless of age, sex, cultural or ethnic background, disabilities, aspirations, or interest and motivation in science, should have the opportunity to attain high levels of science literacy” (National Research Council [NRC], 1996: 20). Why, after two decades, do we continue to be ineffective in reaching the goal of high levels of science literacy for all? How do we create science instruction that meets the needs of students from diverse backgrounds, particularly Latino students?

These questions became an impetus for the work that we report in this study. The need to address the science education of Latino students is part of the authors’ personal experiences. In several U.S. states, including the two states in which we live, the Latino population has increased dramatically over the last decade. For example, between 1990 and 2000, Georgia had the third highest increase in the Latino population of any state (United States Census Bureau, 2000). Moreover, many of these immigrant children come from rural Mexico, as 49% of schools in Mexico are multigrade schools that serve children from rural and indigenous communities (Secretaría de Educación Pública, 2005). At local, state, and national policy levels and in teacher education and professional development for prekindergarten through grade 12 educators, the U.S. educational system has been slow to develop the pedagogical knowledge base to respond to this rapid demographic change.

Science educators and researchers have begun to explore ways of knowing, thinking, and communicating in science in the context of discussions and research regarding science literacy (e.g., Gee, 2004; Hand & Prain, 2006; Lemke, 2001, 2004; Millar, 2006; Yore, 2004; Yore & Treagust, 2006). Yore and Treagust (2006: 295) characterized the components of science literacy as “dual interacting senses”:

Science literacy requires in a fundamental sense that people be proficient in science language, thinking, ICT [information and communication technologies], and emotional dispositions, as well as in a derived sense that they understand the nature of science, the big ideas of science, and the relevance of interactions among science, technology, society, and environment (Hand et al., 2001; Norris & Phillips, 2003).

The fundamental sense of science literacy referred to by Yore and Treagust – that is, proficiency in science language, thinking, ICT, and emotional dispositions – incorporates the kinds of social discourse practices that sociocultural researchers have been locating in science classrooms as well as diverse classrooms serving immigrant students. In many ways, it is this fundamental sense of science literacy that is most unfamiliar to teachers – yet it is critically important to understand and be able to promote if they are to support success in science learning for immigrant and Latino students.

In our work as teacher educators, we were challenged to find ways to support U.S. teachers who strive to enhance the opportunities they afforded their Latino students to attain high levels of science literacy. Central to reaching this goal is developing science pedagogy that is relevant to the lives of Mexican immigrant children (i.e., pedagogy that considers students’ language, culture, and prior experiences with and knowledge about nature and naturally occurring events). We began seeking ways to develop teachers’ perspectives on and access to the broad and rich personal experiences and community-based resources that their diverse students bring to the classroom and in particular to the science classroom.

An abundance of educational research on the sociocultural contexts of learning, and within the field of science education in particular, indicates that diverse student groups bring with them rich prior experiences and knowledge about nature and naturally occurring events, their own ways of knowing, thinking, and communicating – their own social discourses practices – that are drawn from their home and community environments as well as personal experiences (Ballenger, 1997; Bryan & McLaughlin, 2005; Cochran-Smith, 1995; Fradd & Lee, 1999; Garcia, 1995; Lee, 1999; Lee, Deaktor, Hart, Cuevas, & Enders, 2005; Lemke, 2001; Macias, 1990; Mehan, Okamoto, Linz, & Wills, 1995; Olneck, 1995; Rosebery, Warren, & Conant, 1992). Teachers working to develop science instruction that is culturally respectful, responsive, and effective are expected to reflect an understanding of these sociocultural processes and discourse practices of learning within which a wide range of students are accustomed to functioning. Yet, a paucity of literature exists that focuses on the sociocultural environments and personal experiences of children in rural Mexican schools; in other words, we know little about the schooling experiences of Mexican children prior to their arrival in the U.S.A. These formative experiences are often unaccounted for, even though these antecedent experiences comprise part of the foundation of a student’s educational career (Macias, 1990).

No matter what country children emigrate from and immigrate to, they arrive in the new country with ways of knowing and using language as well as social discourse practices from their families, schools, and communities that may or may not be compatible with the predominant discourse or the particular science discourse in their new classrooms. Hence, in order to begin addressing the notion of ‘science for all’ as it pertains to Latino students in U.S. classrooms, we saw a need to conduct research that would support U.S. educational professionals in anticipating and facilitating diverse students’ passage into the potentially unfamiliar cultures of U.S. schooling and science. In our research in rural Mexican classrooms, we paid explicit attention to teachers’ practices and the cultural dimension of day-to-day classroom situations.

These focal points are resonant with the notion that the complexity of classrooms requires that research about teaching and learning adopt a sociocultural perspective focusing on the micro and macro cultural contexts of learning and how students’ social worlds influence the way they make sense of the world (Cobern, 1996). In our research, we investigated the practices of two, rural Mexican teachers as they deliberately and systematically work to empower students to be literate in the social discourses that are important to science. In so doing, we are making an effort to counteract the serious epistemological consequences of remaining uninformed to the complex sociocultural worlds in which children construct science knowledge.

In order to document the voices and practices of teachers working in an authentic setting of rural Mexico, in 2000 we began working with faculty at the Benemérita Escuela Normal Veracruzana “Enrique C. Rebsamen” in Xalapa, Mexico. Faculty at this well-respected and long-established teacher education institution (established in 1886) introduced us to two teachers, two one-room multigrade schools, and two rural communities. These schools were designated as two of the seven annex schools associated with the Escuela Normal. Annex schoolteachers are selected for their expertise in teaching and their willingness to include practicum students from the Escuela Normal teacher education programs in their classrooms. When the two teachers received their initial teacher education and continuing until recently, the teacher education program at the Escuela Normal emphasized preparing young people from both rural and urban backgrounds to teach in the high number of rural schools that were regularly in need of teachers. The second author of this paper initially established a role as a visiting educator, leading groups of undergraduate and graduate students in yearly study-abroad programs that included visits at the two rural school sites. Eventually, both authors negotiated relationships as researchers with the teachers and received official sanction for our research from both the Escuela Normal and the Secretary of Education for the state of Veracruz.

1.1 Montecito and El Bosque

1.1.1 Montecito

The community of Montecito is located in the foothills of inland Veracruz state near a small town; but for families who travel on foot and by bicycle, a trip to town occurs rarely. Humble family dwellings provided by the coffee plantation owners tend

to be widely dispersed among large coffee landholdings. The adults are mainly migrant coffee pickers with very limited financial resources, few years of schooling, and low levels of Spanish literacy. A majority of the families in this small community belong to a 50-year-old, conservative, evangelical, Protestant community church notable for the narrow roles it proscribes for women. Women do not cut their hair, do not wear pants, and are reluctant to speak or make decisions without their husbands' approval. In addition to the religious beliefs and values influencing family and community life, experiences as part of the traditional Mexican rural sociocultural context framed families' and children's worldviews. A regional dialect of Mexican Spanish is spoken at home and at school.

Montecito represents a community and a school in constant flux; only approximately one-fourth of the families remained in the town during the last two years of data collection. High mobility among families was the result of the economic crisis in coffee production, which led families to migrate to find agricultural work in other areas of Veracruz and nearby states in Mexico. Montecito's primary school is close to the beginning of the town and surrounded by a wall of colorfully painted handprints from its students. The community recently built a yellow structure of bathroom stalls and sinks situated to the left of the school's entrance. To the left and the right of the sidewalk leading to the school's entry door are small grassy areas lined with bougainvillea. Inside, there is one large room sectioned into two instructional areas. Three of the four walls have large windows that span approximately half of the wall's height.

The primary school in Montecito has about 24 students in six grade levels, led by a teacher named Lena. Some students will continue their education beyond grade 6, but many will not. There are about six sibling groups in the class. Each year one or two students will not be promoted to the next grade level but instead will be held back for remediation. Half of the room is devoted to the students' seating area, where they sit in self-selected, multi-age groups of two to six students. Half of the other side of the room is reserved for small collections of books, animal skeletons, preserved specimens, and other instructional materials. A long table, extra desks, and a sitting area occupy the second half of the other side of the room. When students conduct showcases (e.g., puppet shows, ceremonies) or rehearsals for upcoming festivals (e.g., dances, dramas), they clear out this side of the room to serve as the stage.

Lena has been the *maestra* [teacher] in Montecito for eleven years. At the time of the study, she was completing coursework in a master's degree program in education. She is a dynamic woman yet possesses a quiet and somewhat subdued demeanor. Lena is a skilled conductor of the classroom, often orchestrating several multi-age, small-group activities simultaneously. Her commitment to providing an excellent education to rural children is evident throughout transcribed interviews, transcriptions of videotaped classroom events, and observers' fieldnotes. She is socially active in the Montecito community, organizing and implementing various programs and events to involve students and parents in improving the school, community, and their lives.

1.1.2 *El Bosque*

Approximately 30 miles east of Xalapa, Veracruz, in the coastal lowlands is a small agricultural community of nearly 270 people. The families of El Bosque have lived there for generations and own their houses and small plots of land where they cultivate home gardens of fruits and vegetables. Mango, papaya, and chayote harvesting, as well as raising corn and beans, are the predominant occupations in El Bosque. While the residents live below the poverty line, they strongly support their children's education. As in Montecito, a regional dialect of Mexican Spanish is spoken at home and at school. Most parents have developed basic literacy skills in Spanish and have attended primary school. Family and community life is centered on traditional Catholic religious practices and celebrations (e.g., the festival of the local patron saint), rites of passage (e.g., the *Quinceanera*, a party for 15-year-old daughters), and celebrations of Mothers' Day, Fathers' Day, Teachers' Day, and Grandparents' Day. The religious practices in El Bosque are more traditional Mexican Catholic practices, in contrast to the Protestant evangelical practices in Montecito.

El Bosque is located in a different climatic zone than Montecito, but the community fund of knowledge about nature and naturally occurring events grows similarly out of families' observations of seasonal and weather conditions and the animal and plant life that surrounds them in their daily work and play. Community worldviews are framed in a traditional Mexican rural and agricultural sociocultural context, similar to Montecito.

El Bosque has one school, situated along a string of colorful stucco, brick, and cement-block houses in the middle of the main street in town. In front of the school building is a cement courtyard where children have recess, mothers gather at morning break time to offer food and drink to their children, and the community holds public performances for ceremonies, such as the *Fiesta Patronal* [Celebration for the Patron Saint]. The interior of the school consists of one large room, approximately 20 ft. x 60 ft., that is separated into two general work areas – one side with groups of student desks and large chalkboards, and the other side with area rugs for sitting and shelves of artifacts and instructional materials (e.g., a small library of books, a collection of maps, a natural history museum consisting mostly of animal skeletons and preserved specimens).

Approximately 30 students, grades 1 through 6, attended the school in El Bosque. Like Montecito, children come to the classroom with a wide range of cognitive abilities, physical abilities, behaviors, and educational goals. Five children with varying degrees of special needs were integrated into the classroom. Many of the students will go to *secundaria* [middle school] after completing sixth grade; a few students will terminate their education then. Students in this classroom are seated in groups by age, with between two and seven students in each group. In the back of the room, there is a door that leads to a grassy courtyard and a small structure that houses restrooms and showers.

The teacher in this small, one-room, multigrade school is Alberto. Alberto has been a *maestro* [teacher] in rural Mexican schools for more than 25 years. In 2000, when the research project began, he was in his sixth year at the school. He holds a master's degree and has conducted professional development courses for other

teachers in Veracruz. Alberto is a reflective man of quiet demeanor whose face reveals his seriousness of purpose. In the hundreds of hours that we observed him teach, we never once heard him raise his voice beyond a normal projection. He is a gentle yet strong-spirited individual who was in constant motion in the classroom. He was a *maestro* in both the English as well as the Spanish use of the word – Alberto was adept at orchestrating six different grade levels of instruction, moving from group to group, asking questions, offering examples, exhorting students to continue working, and checking progress.

It should be noted that both Alberto and Lena grew up in more urban environments than the students whom they taught. In addition, at the time of the study, both Lena and Alberto lived in the city of Xalapa, the Veracruz state capital. They were considered middle-class – more socioeconomically privileged than the families in the communities where they taught. The teachers, like the majority of Mexicans and like the families of their students, were from a *mestizo* [mixed race] background. Earlier generations of their families had included intermarriage among regional indigenous groups and Spanish immigrants to Mexico. In current times, however, the teachers and families alike identified themselves ethnically and culturally as Mexicans. Lena and Alberto spoke standard Mexican Spanish in contrast to the regional dialects of the communities where they taught.

2. RESEARCH DESIGN

The findings in this paper are from a longitudinal research project spanning four years in which we examined the nature of teaching and learning in the two, multi-grade, rural Mexican classrooms of El Bosque and Montecito (Bryan & McLaughlin, 2005). The design of the study was an interpretive, multiple-case study in which each site constituted a case. In total, we conducted nonparticipant observations of more than 200 hours in El Bosque and 80 hours in Montecito. During observations, one researcher collected field notes concerning class environment, class activities, and teacher and student activities; reactions and interpretations about observations; and student comments during small and large group discussions. In addition, we actively participated in local events, such as family and community meals, fiestas, and a mountain hike. Participation in these events always was initiated by an invitation from the teacher, families, or community groups, such as the *Comité de Madres* [mothers committee]. To supplement the observations, we video recorded more than 22 hours of naturally occurring classroom instruction in El Bosque and 6 hours at the local events. During visits to Montecito, we video recorded approximately 15 hours of naturally occurring classroom instruction. Over the years, we also captured everyday moments of teaching, learning, and community activities in more than 300 still digital images.

Throughout the project, we engaged in countless formal and informal conversational interviews in Spanish with the teachers to gain a thorough understanding of their teaching. Eight impromptu and three planned interviews with Alberto and Lena, respectively, were conducted and recorded. All recordings were transcribed in Spanish and translated into English by native Spanish speakers. Finally, written

documents included Alberto's planning book, students' classroom work, classroom handouts, students' drawings, and emails exchanged between researchers and teachers.

We conducted the data analysis by repeatedly reading the written data sets and repeatedly reviewing the videos. For each videotape, we systematically recorded events in chronological order (every 1 to 30 seconds of video), discussed as a team the events portrayed in the videos, and documented analytical memos that reflected our discussion of the patterns of teachers' social mediations of their first through sixth grade students' learning. As a team, we developed categories and subcategories to code the data. We reviewed the coded data and organized findings according to evidence of authentic contexts of instruction and patterns of social discourse practices. We sought to enhance credibility of the findings by seeking convergence of multiple sources of data on each pattern, by having researchers analyze data independently and as a team, and by conducting member checks of data and findings with Alberto and Lena.

3. FINDINGS

Lena and Alberto organized their instruction, and science instruction in particular, to mediate the border crossings between school, science, and home discourse communities for their students. There were different goals for science instruction for different students, but the teachers wanted all students to have access to and appreciate science. Both Lena and Alberto taught students who would go on to *secundaria*, students who would complete their education only through grade 6, as well as students who had special needs. Their instructional practices allowed a continuum of goals and needs to be met.

The teachers' social mediations (Moll, 1988) were based on their belief that there are important funds of knowledge (Gonzalez, Moll, & Amanti, 2005) for teaching in their schools' immediate communities. Not only were Alberto and Lena aware of these funds of knowledge, but they also were epistemologically committed to using these resources to mediate students' transitions between science, school, and community contexts. One important means of social mediation was the teachers' commitment to constructing authentic contexts for instruction – 'authentic' meaning relevant to the learners as opposed to a facsimile of laboratory science. In addition, both teachers facilitated the learning of three sets of social discourse practices that were integral to science teaching and learning, as well as integral to learning in other content areas. The three sets of social discourse practices identified were: responsibility and autonomy, cross-age interaction and collaboration, and public performance.

3.1 *Authentic Context of Instruction*

A powerful sociocultural characteristic of *la vida cotidiana* [everyday life] in the Montecito and El Bosque schools was the authentic context of instruction about nature and naturally occurring events that drew from the students' experiences and

environment. This context was invariably the community in which they lived; hence, lessons and inquiries reflected the natural world around them. The classrooms were not filled with as many books as one might find in a U.S. school, the school in Montecito had no TV or VCR, and neither school had a computer or equipment and materials from catalog companies (e.g., Foss or Delta Education kits). To teach science, both teachers and students had to be resourceful; indeed, they took advantage of what we came to see as the wealth of local resources including local knowledge about nature and naturally occurring events. Yet it was not simply a matter of necessity; both Lena and Alberto were adept at capitalizing on these funds of knowledge.

For example, to initiate a life science lesson about animals and their habitats with third grade students, Alberto led a discussion in which the students established a list of various animals, particularly those indigenous to not only their own community but also other regions of Mexico that they wished to examine (Video CP7). He designed this lesson for learning concepts outlined in the third grade natural science curriculum and student text (Secretaría de Educación Pública, 1993). As he did in many areas of the curriculum, he designed a lesson for investigating these concepts through the exploration of local knowledge the students had constructed in their home and community environments.

Alberto began by standing at the chalkboard that was located in front of the third grade cluster of desks where the students were seated arrayed in two small tables. All around them were small groupings of the other 20 students working on different activities. He outlined a large chart with the group of 8 third graders (4 boys and 4 girls). The chart was for each student to record individual observations of animals in the community and, later in the lesson, as a basis for the students to share and explain their observations.

As Alberto explained how to draw and label the different parts of the chart, he explicitly directed the students away from using their natural history book as a resource for ideas about animals to put in the chart; he insisted that they name animals they know that will be the objects of their observations. When one student said squirrels, Alberto queried the children whether or not the squirrel is really an animal that they know in their community before he agreed to include it in the chart. They responded that they knew squirrels, so Alberto added it to the chart along with cats, rabbits, and dogs.

Alberto then prompted the students to think about these animals' habitats by seeking a more elaborated title for the animal observation chart, as indicated in the following:

<i>Original Spanish</i>	<i>English Translation</i>
Alberto: ¿Qué título le pondríamos aquí?	(<i>Alberto points to top of chart</i>). What title will we put up here?
Niños: Animales.	Children: Animals.
Alberto: Bueno, Los animales, ¿verdad? Así, ¿nada más? Si queremos especificarlo le tendríamos los animals de la ...	Alberto: Good. The animals. Right. So nothing more? If we want to specify that we have animals from the ...
Niño 1: Selva!	Child 1: Forest!
Alberto: No, aquí no hay selva. A ver, ¿aquí el gato vive en la selva?	Alberto: No, there is no forest here. Let's see, does the cat live in the forest?
Niños: No.	Children: No.
Alberto: ¿El conejo vive en la selva?	Alberto: Does the rabbit live in the forest?
Niños: No.	Children: No.
Niña 2: Los animales del monte.	Child 2: Mountain animals.
Alberto: ¿El gato vive en el monte?	Alberto: Does the cat live in the mountains?
Niños: No.	Children: No.
Niña 2: El gato monturno.	Child 2: Mountain lion.
Alberto: Entonces tenemos que ponerle el gato monturno. El perro monturno ¿Quien dijo "gato"?	Alberto: Then we have got to put mountain lion. Mountain dog. Who said "cat"?
Niña 2 levanta la mano. ¡Yo!	Child 2 raises her hand. "Me!"
Alberto: ¿En qué gato pensaste?	Alberto: What cat were you thinking about?
La niña responde con una descripción del gato en la casa.	Child 2 answers with a description of the cat at home.
Alberto: ¿Era monturno?	Alberto: Was it a mountain cat?
Niña 2: No.	Child 2: No.
Alberto: Ah, de tu casa. El perro ... ¿Quien pensó en el perro? ¿Y cual perro era?	Alberto: Oh, the cat is in your house. The dog ... who thought about the dog? And which dog was it?
Niño 3 explica el perro de la familia.	Child 3 explains about his family dog.
Alberto: Nada más dijiste "perro" y ya. Bueno. Entonces no podemos poner la selva o monturno. Nada más "Los animales" ...	Alberto: So you just said "dog" and nothing more. Good. Then we can't put the forest or the mountain. Nothing more than, "The animals" ...
Niño 4: ¡Del pueblo!	Child 4: of the town!
Alberto: A ver. Mario dice "del pueblo."	Alberto: Let's see ... Mario says "the town."
Alberto escribe "del pueblo" después de "Animales" en la carta. Ya. Bien.	Alberto writes "of the town" after "Animals" in the title of the chart. Done. Good. (Video CP7)

As they concluded the elaborated title for the chart, Alberto and the students together clearly situated their upcoming inquiry and observation of animals in their local community, building on their local knowledge of animals. After generating a list of suggestions and voting on different choices, the students then decided on the categories of information that they would collect on local animals, what sites to visit to collect or verify data, and how to compile information. Some of the information included describing where the animals lived, what food they ate, and when in a day the animals were most active. As Alberto helped the students construct a grid for recording their eventual observations, he made clear his expectation that they would investigate animals and their habitats that were part of the local and community

funds of knowledge. He then left them to discuss and debate their ideas. Before filling in the chart with their predictions, these young students made proposals to each other and provided the rationale for their individual proposals, which are social discourse practices characteristic of western science. Students later divided responsibility for observing local animals (dogs, cats, rabbits, squirrels) for data collection. Some students observed the animals owned by their families; others asked their parents and neighbors about the animals. Students brought in artifacts for the natural history museum that related to their investigation – skeletons, skulls, preserved specimens, and even desiccated animals. In Lena’s classroom, a similar collection existed from life science lessons. Lessons like this one were not structured around textbooks and encyclopedias but rather were set in the context of a part of the children’s lives with which they identify themselves – as pet caretakers, livestock owners, or members of a local ecosystem.

In Lena’s classroom, science also most often was set in the context of inquiries that connected to the students’ personal lives and culture. As part of the beginning of a lesson on compounds and mixtures, Lena had arranged with the mother of a sibling group to bring in a local beverage – a fortified blackberry beverage made from handpicked blackberries, water, sugar, flour, and spices, and served warm (Video JB6). Knowing that this beverage was an important part of the students’ diet (as most families could not afford to buy milk), Lena chose to introduce her lesson with a resource that students encountered in their everyday life. Constructing a lesson with chemicals, materials, and other items that might be acquired in a city store held little direct relevance to her students. Lena utilized those things her students would find in their homes and in *la vida cotidiana*; the community often supported Lena in her instruction, as evidenced by the following:

<i>Original Spanish</i>	<i>English Translation</i>
<p>Recibimos un gran apoyo de la comunidad del Montecito. Los niños pueden salir y realizar estas actividades. [Los niños] practican algunas recetas, preparan o reciclan materiales ... [Los niños] visitan las casas que están cerca de la escuela buscando ollas para hacer sus piñatas, los materiales para preparar el engrudo [un pegamento hecho de harina y agua], para hacer experimentos, realizan entrevistas y obtienen tierra para el jardín, como hicimos no hace mucho tiempo.</p>	<p>We receive a lot of support from the community of Montecito. Children can go out and carry out these activities. [The children] practice recipes, prepare or recycle materials ... [the children] go to the house close to the school to look for bowls to do their piñatas, material for engrudo [a glue made from flour and water]; for experiments, they can do interviews or get soil for the garden, as we did not long ago. (Interview, 7/11)</p>

More than a decade of research on sociocultural issues in science learning indicates that students respond more positively to science instruction that incorporates sociocultural knowledge of their lives and experiences (e.g., Aikenhead, 2003; Ballenger, 1997; Cobern & Aikenhead, 1998; Lee et al., 2005; Lee & Fradd, 1998; Rosebery et al., 1992). This certainly seemed to be the case for the El Bosque and

Montecito students, who appeared to be used to thinking about science in a context that was relevant to their lives. In the following excerpt, a research assistant described an instructional scene in Montecito that was not unusual:

Children are taken on a nature hike into the beautiful surroundings that encompass the small school. The children freely explore nature with their friends and have little supervision by adults. Students enjoy the nature hike at their own pace and are not forced to remain in a group. Some students run and play with a ball, while others choose to walk with friends. No parent permission slips are necessary for this activity, because it is part of everyday life in their community. When the children stop to eat lunch, several students and a teacher choose to eat on top of a boulder located in the middle of the river. Neither students nor teacher react with fear while climbing onto the rocks. Throughout the nature hike, children explore exotic flowers and plants that grow abundantly in their community. These natural surroundings are utilized by the school in a variety of ways, and incorporated into the curriculum to help children learn. (Analytical notes, RB1)

While spending a morning in nature is not in itself that notable, what is impressive is the science content knowledge that students gained through the integration of such nature walks and how the teachers regularly made explicit the value of the surrounding community as a context for learning and instruction. For example, Alberto recognized and capitalized on a cultural resource in El Bosque – the ethnobotanical knowledge of a student’s grandmother – by designing a medicinal plant tour for her to lead the students as part of a larger unit on plant life/diversity of life. During such tours and walks in the community, the language that flowed between teacher, students, relatives, and/or guests did not include the language of horticulture (binomial nomenclature) but rather common local names. Plants were discussed in terms of local uses (e.g., aloe plant’s ointment for rashes and burns, *nopales* [prickly pear leaves] for consumption in salads or as a dietary aid for diabetes). From this and other similar experiences, children as young as first grade became adept at identifying a myriad of flora and fauna. At a young age, students were able to draw in accurate detail parts of plants found in their local community. They knew the lifecycles and growing seasons of trees, plants, animals, and insects in the local area. They were able to explain how the wheel-and-axle system of a well worked and construct two- and three-dimensional geometric shapes with clay and sticks from their own backyards (Videos CP5, CP7, RB7). The teachers’ use of local contexts for learning established a common ground of local language and observations of phenomena that were meaningful to the students. Lena and Alberto were able to draw upon these rich resources to embed school knowledge about science into the everyday home and community context of their students’ lives.

3.2 *Social Discourse Practices in the Classroom*

Both Alberto and Lena organized *la vida cotidiana* in their classroom in ways that socially mediated transitions between school, science, and home cultures. Specifically, there were three salient social discourse structures routinely embedded in the teachers’ practices that were congruent with students’ life outside of school and outside of science: (a) affording students significant responsibility and autonomy, (b) engaging students in cross-age interactions, and (c) utilizing public performance as a means of accountability.

3.2.1 *Responsibility and Autonomy*

Everyday life in the classrooms of El Bosque and Montecito afforded students numerous opportunities to take and develop a strong sense of responsibility. For example, both Lena and Alberto promoted students' development of responsibility to oneself in the form of self-monitoring. Students came and went from the classroom as necessary and, for the most part, when appropriate. Teachers did not distribute hall passes; students did not have to ask permission to go to the restroom. Students had the autonomy to move, converse, group, and regroup themselves as necessitated by that day's work. Lena and Alberto routinely encouraged students to monitor the progress of their own academic work in both private and public settings. Because each teacher had to juggle lessons for multiple grade levels – but also because both teachers valued student responsibility and autonomy as instrumental for participating in meaningful ways as learners in the classroom community – students learned to monitor their own progress and help each other. For example, strolling down the sidewalk to Lena's school on any given sunny day, we found students huddled in a quiet corner or spread out on the grassy school yard to work on assignments, such as constructing geometric figures, playing with word dominoes, and reading stories to each other (Videos JB2, JB5, JB6, RB4). Seldom would Lena have to reprimand students for being loud, off-task, or any other misbehavior. They appeared to have an awareness of what they needed to accomplish and a mission to complete their work without constant supervision from the teacher.

One of the teachers' epistemological commitments married with the responsibility aspect of social structure was the teachers' belief in meaning making. Routinely, students were expected to take responsibility for expending the mental effort to make sense of what they were learning. In most activities, students vacillated between moments of individual manipulations (print/graphic production, such as writing or drawing) and group discussions. For example, as second graders worked on grouping beans in sets of three (a premultiplication activity), students completed their own set. Each student had a big sheet with rows of large circles in which they placed beans in groups of three. They kept track of how many groups of three and the total number of beans on their sheet. As they completed each exercise, they compared their groupings and total numbers with each other. When discrepancies arose, students would give their argument and then come to some resolution that would be checked momentarily when Alberto came by to ask about their progress (Videos RB7, RB8).

As the teachers walked around the groups, they asked questions, helped clarify meaning, and expanded thinking. Students were responsible for monitoring their own and each other's engagement. There is a level of reciprocity in this social structure that involves trust – the teachers entrust students to take responsibility and, in turn, the students want to keep the privilege of that responsibility so they engage in the learning tasks. As one might expect, however, there are occasions when students do not remain on task, daydream, or otherwise 'mess about'. As the next example shows, when a student chooses to do nothing, the teacher's response is a simple, non-confrontational directive to encourage self-monitoring (Video CP4):

<i>Original Spanish</i>	<i>English Translation</i>
Alberto: ¿Qué haces, Angel?	Alberto: What are you doing, Angel?
Alberto: ¿Qué, qué haces?	<i>Angel looks up from his seat.</i>
Angel: Nada.	Alberto: What, what are you doing?
Alberto: ¿Nada? Entonces, mejor sí vas a tu casa sí no vas a trabajar.	Angel: Nothing
	Alberto: Nothing? Then, it's better to go home if you're not going to work.

Alberto's tone during this exchange was not harsh or angry but rather direct and serious. Alberto simply communicated his expectations. In the case of Angel, Alberto expected him to work with a partner on their family trees as part of a lesson on inherited physical traits of offspring. The short exchange between teacher and student was enough for Angel to halt the unimportant things he was doing and get to work. Toward the end of class, Angel approached Alberto with the completed assignment; and the two of them sat in the room discussing Angel's work while the rest of the class was outside for the morning break.

In Lena's class, we frequently saw her directly teaching and requiring the students to monitor and evaluate the social discourse practices that she considered being important in science inquiry (as well as other areas of the curriculum). For example, in preparing students to conduct an investigation of mystery liquids, Lena modeled a process for not only self-monitoring one's engagement in the lesson but also monitoring peers' engagement in the lesson. In addition, she expected students to include written reflections on what they learned as part of the science inquiry activity. The excerpt below describes the context of the activity:

Nine 3rd-6th grade students are sitting on wooden chairs around two small wooden tables pulled together. They have their notebooks and pencils in front of them. The other 20 students in this class are sitting, working in groups of 4 to 6 on other activities, arrayed around the big open space of the classroom. Lena is standing near the group of 9 students, holding up a chart as an example of what they are going to work on. The chart is designed for students to monitor and evaluate each other's and their own participation and learning in the upcoming science "experimental activity" involving mystery mixtures about which they are going to observe and make hypotheses. Lena gestures and points to different parts of the chart as she explains the task they will be doing in a few minutes. She also gestures as she's talking in order to model activities like writing and observing. (Analytical notes, MAS)

As Lena discussed the chart and the different kinds of behaviors the students were going to observe and evaluate for each other and for themselves, she conveyed the guidelines and expectations for the social discourse practices expected in the upcoming science investigation:

<i>Original Spanish</i>	<i>English Translation</i>
<p>Lena: Se observa con atención todo. Porque hay niños que en la actividad experimental que se dan la vuelta y no vean nada. Hablan de cosas que no vieron. Entonces, observaron y no observaron. Y si opina, si dice lo que piensa, todo que va a pasar, no obedecerse o sí obedecerse. Aquí lo van a poner "Sí" o "No".</p> <p>Si registra, pueden registrar con dibujos o pueden registrar con palabras o como escrito.</p> <p>Niño 1: ¿Cómo se registro?</p> <p>Lena: ¿Cómo se registra? Que va haciendo, que va pasando, que se va utilizando. Y le ponen "Sí" o "No". Y al final, esto le voy a hacer. Yo lo voy a llenar con cada uno de Uds. Anota conclusiones. Y al final que cosa pasó, que aprendió y no aprendió. Esto lo van a seguir todos.</p>	<p>Lena: You need to observe everything with [careful] attention. Because there are children in the experimental activity who run around and don't see anything. [Then] they talk about things they haven't seen. So, [you mark that] they observe or they don't observe. And if they offer their opinion, if they say what they think or what is going to happen, [you mark it here]. Not obeying or if they obey, [you mark it here.] Here you are going to put, "Yes" or "No."</p> <p>If you record [your observations] you can record with drawings or you can record with words, written [words].</p> <p>Child 1: How do I record?</p> <p>Lena: ¿How do you record it? What they're doing, what's happening, what they're using. And you put, "Yes" or "No." At the end, I am going to fill in this part [my evaluation of your participation in the experimental activity]. I'm going to fill it in on each one of you. Note [your] conclusions. And at the end, what happened, what you learned and didn't learn. Everyone is going to fill this out. (Video JB6)</p>

The self- and peer-monitoring examples above illustrate how Alberto and Lena integrated expectations for responsibility and autonomy in a way that required students to become metacognitively aware of social discourse practices they would need to engage in to be successful learners of science. Teaching and learning these social discourse practices was given priority in a short, intensely packed school day that only ran from 8:00am to 12:00pm daily.

To a great extent, students had autonomy to create the classroom environment for learning and make curricular decisions. Choice was a central part of the social structure in these classrooms. The Montecito and El Bosque students regularly engaged in experiences where individuals' participation, thoughts, and ideas were valued; and individuals had opportunities to contribute to the collective life of their classroom. Students' ideas were respected and used. These practices helped anchor the instruction in the students' world and prior experiences. For example, science teaching and learning in rural classrooms is guided by a national curriculum (as are the teaching and learning of other subject areas). Although Lena and Alberto were ultimately in charge of the classroom and had the definitive input in students' science learning, they each employed a number of ways to allow students to assume responsibility in making curriculum-related decisions. Because the science curriculum in grades 1 through 6 was integrated science, multi-age activities in which the entire class could participate (at age-appropriate levels) were common. In Lena's classroom, students regularly prioritized the day's or week's classroom activities, deciding as a group what they should accomplish. For example, when studying states of matter, the class as a whole decided to begin the day with a continuation of

their investigations. However, the primary age children worked on a different investigation than the fourth, fifth, and sixth graders (Video JB7). At least once a week, the entire class began their instructional day with a meeting to determine what they would work on and the priority of accomplishing these tasks. These meetings were led entirely by students. When the activities were not a continuation of previous lessons, Lena provided the choices. Students from all grades offered ideas for different activities and a rationale for their priority. Throughout this time, Lena stood at the side or in the back of the room, never intervening during the discussions and voting (Videos RB5, JB2).

In Alberto's class, the scene was similar except the class president led the discussion. After a list of activities was completed, the students who made proposals stood and addressed the class about their reasoning for assigning priority to their activity. Afterwards, classmates had the opportunity to retort. We often witnessed one of the older students walk over to the list of national standards posted on the wall and check off the benchmarks that they had covered in the day's class. Alberto expected his students to be aware of the academic curriculum and to make some of the decisions about how and when to address standards within the curriculum (Video RB12).

3.2.2 *Cross-Age Interaction and Collaboration*

Reflective of the children's lives outside the classroom, nearly every aspect of instruction in the one-room, multigrade schools involved cross-age interaction and collaboration. In El Bosque students sat in grade-level groups, while in Montecito students sat in mixed-aged groups according to their own preference. As described previously, students shared materials and ideas, solved problems together, and even taught each other while the teacher was navigating about the room. Sometimes students worked in same-age groups, and other times they worked in multi-age groups.

An interesting instructional strategy that both Alberto and Lena employed, particularly in science instruction, was to send students from one age group to observe and talk with students from other age groups. For example, older students were responsible for checking younger students' writing, ascertaining their progress, asking questions, and helping them if needed (Field Notes 6/15; Videos RB6, RB7, JB3, JB6, CP7). When the fourth grade students were learning about the excretory system, the fifth grade students were divided among the first and second graders to listen to their narratives about solids, liquids, and gases and field questions, such as *¿Qué son las nubes?* [What are clouds?] (Video CP7). When the sixth graders began constructing simple machines, eager students from other grades came over to observe and listen to them explain the workings of their machines (e.g., levers, inclined planes). Neither Lena nor Alberto designated a timeline for such observations. Sometimes these cross-age interactions were instigated by the teachers and other times by students' interests. Nonetheless, the younger students carried out the task of reading and sharing their writing with the older students, while the older students took seriously the responsibility of monitoring the younger students' progress.

3.2.3 Public Performance

A third significant and fundamental social practice in the classrooms of Lena and Alberto was students' public performances. Students were held accountable for their opinions and ideas whether in an *asamblea* [whole class meeting], a small group discussion, or a one-on-one conversation with the teacher. Central to students' presentation of ideas was a rationale or evidence to support their choices – the nature and discourse of science. It was normal for classmates to respond by asking questions and offering critique. Students learned from one another rather than viewing the teacher as the sole source of information and knowledge, they learned how to develop a line of reasoning to support their assertions, and they learned to anticipate and respond respectfully to critique. Students were challenged to become more aware of the importance of what they said and to be accountable for the quality of their responses, much like authentic science in contemporary research groups (Florence & Yore, 2004; Yore, Florence, Pearson, & Weaver, 2006). During whole class meetings, Lena and Alberto were often in the back of the room or to the side, out of the students' view. They interjected when a discussion became too lengthy – e.g., *Bueno, necesitamos una propuesta concreta.* [OK, we need a concrete proposal.]; *Es el momento de votar.* [It is time for a vote.] – or when a student needed to extend or expound upon a point – e.g., *Aún tienes treinta segundos para hablar. ¿Qué más puedes decirnos?* [You still have 30 seconds to speak. What more can you tell us?] – or when students had questions (Videos CP2, CP4, CP6, RB12, JB3). This pattern of open discussion and publicly providing justification for one's proposal was seen in Lena's and Alberto's classrooms beyond whole group discussions. The students often mirrored this democratic way of making decisions and the expectation for a justification in their small groups.

Another regular classroom practice of Alberto's that was a form of public performance involved students sharing their reflective journal writing with each other. Two or three times a week, Alberto began the instructional day by asking students to share what they had written in their *diario*. All students kept a record of their reflections on learning in school. At times, Alberto would provide the focus for reflection; at other times, the students chose. One feature was constant: students reflected on their learning as opposed to summarizing an activity or the day's events. During the mornings in which students shared their *diarios*, three or four students from different grades were chosen to speak. Presenters stood by their desk and read to the class. Alberto provided his critique and allowed classmates to provide critique as well. Alberto's critique was most often directed at extending students' writing, enhancing the depth of reflection, or encouraging more effort. He never publicly criticized their actual writing skills (Videos RB3, RB7, RB8). For example, in the following excerpt, Alberto provided his critique after three students from three different grades read their *diarios*:

<i>Original Spanish</i>	<i>English Translation</i>
<p>Bueno, Hay algo allí en los diarios que están muy pobres en el sentido de que ... hablan de que llegaron, que se fueron, que jugaron, pero no dan detalles de que hicieron. Si ... ¿A qué me refiere con los detalles? Bueno ... Si trabajaron en el caso de español, ¿Qué tema y qué aspecto se vió el español? Si se fué sobre historia, qué aspecto se vió sobre historia, ¿Cómo se llevó a cabo el trabajo?</p> <p>Esto es importante que en los próximos trabajos que se lo consideran porque es importante. Claro, que es también muy importante que Uds. Se levantan, se van a bañar, desayunan y vienen a la escuela. Pero es algo que hace normalmente un niño o una niña. ¿Sí? Y sí, el diario debe tener más información relacionada con lo que está ocurriendo aquí, con lo que cada uno está <u>apren-</u> <u>diendo</u>. Con lo que cada uno de Uds. aprende o con lo que cada uno de Uds. tiene dificultad para trabajar o hacer.</p>	<p>Well, there's something in the diaries that is very poor in the sense that ... they talk about how you arrived [at school], that you left, that you played, but you didn't give any details about what you did. Yes ... What am I referring to [when I say] details? Well ... If you are working in the subject of Spanish, what theme or what aspect was seen in the Spanish [lesson]? If it's about history, what aspect of history did you see; how did you accomplish your work?</p> <p>It's important in your next work [on the diaries] that you consider [these details] because they are important. Clearly, it's also important that you get up, bathe, eat breakfast and come to school. But that's also something that a boy or girl does normally [every day]. Right? And yes, the diary should have more information related to what is occurring here [in the school], with what each one of you is <u>learning</u>. [Information related to] what each one of you is learning or with what each one of you has difficulty with in terms of what you are working on or doing.</p> <p>(Video RB7)</p>

Alberto offered his honest, yet pointed critique of the diary writing the students completed and guided them to include more details in their diary entries, with the clearly outlined goal of recording more information about what they were learning and what they were having difficulty with in the classroom. This episode is an example of the way in which he routinely integrated an expectation for the students to metacognitively reflect on and articulate what they were learning in the different subjects in their daily classroom experiences.

Interestingly, public performance was a social structure of the classroom that Lena and Alberto explicitly linked in their own ways to the local community through students' parents. During his first year in El Bosque, Alberto organized a *Comité de Madres*. Likewise, in Lena's first year at Montecito, she began holding quarterly parent meetings (Video JB1). Mothers in El Bosque and parents in Montecito held meetings in the classroom, often during school hours while the students were at recess or working on their assignments. Meetings were similar to the whole group *asambleas*; the groups were self-running as the president called the meeting to order. When discussions took place, meeting participants listened to each other in turn and were encouraged to provide a rationale or support for their expressed position or assertion. Matters were voted on with non-secret ballots. Lena typically was given time on the agenda to discuss matters about classroom life that she wanted parents to know: matters of student learning (e.g., upcoming national standardized exams), matters of personal health (e.g., the milk program, daily teeth brushing at

school, weekly lice checks), and matters of community involvement (e.g., invitation to an upcoming school puppet show designed and run by students) (Video JB2). Alberto often did not take time on the agenda but encouraged mothers to set their own goals, priorities, and agendas for the meetings. Lena's and Alberto's involvement with parents reflected their conscious decision to be a part of their students' community. Though these meetings are just one example, we observed numerous occasions where each teacher made deliberate efforts to visit and get to know members of the community, making explicit their belief in the importance and value of community in their students' lives and their own lives as well.

4. DISCUSSION

As science education researchers investigate the development of science literacy in the socioeconomically, culturally, and linguistically diverse classrooms of contemporary society, they have examined instructional practices that empower students to become literate in the discourses of science (e.g., Fradd & Lee, 1999; Lee et al., 2005; Rosebery et al., 1992). The social discourse practices that we uncovered in Montecito and El Bosque are examples of the kinds of cognitive tools and communication skills deemed important in current thinking about science literacy (e.g., Hand & Prain, 2006; NRC, 1996, 2000; Yore, 2004; Yore & Treagust, 2006). It should be noted that we are not claiming to have found new social discourse practices. We did, however, observe these social discourse practices to be so common and so frequent that we considered them to be cultural features of these two classrooms. And we observed these instructional and learning practices to be instrumental in promoting science literacy in the two classrooms.

The social discourse practices that we observed in the rural Mexican classrooms of Montecito and El Bosque can be seen as potential foundations for engaging in culturally responsive, inquiry-based, science instruction grounded in the authentic ways of learning science that these students and families are likely to have encountered. These social discourse practices resonate in many ways with key social discourse practices of inquiry-based learning as advocated in current U.S. science education reform initiatives (see Crawford, 2000; NRC, 1996, 2000). For example, according to the *National Science Education Standards*, inquiry-based teaching and learning requires that the students' role in learning is one of responsibility:

Teachers of science guide and facilitate learning. In doing this, teachers challenge students to accept and share responsibility for their own learning. (NRC, 2000: 22)

Teachers [of scientific inquiry] enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community. (NRC, 2000: 23)

Research cited by the NRC to support this assertion about inquiry demonstrates that learners who take responsibility for their learning articulate their ideas, evaluate their ideas in light of other sources of information, and provide reasons for their opinions and claims. We suggest that an examination and analysis of the social discourse practices used by Alberto and Lena to promote students' assumption of re-

sponsibility and the expectation that they participate in a public performance could yield insights into how these processes might be adapted in other science classrooms serving Latino and immigrant students.

A particular challenge offered by inquiry-based teaching and learning approaches requires that learners interact and communicate with each other (NRC, 2000: 23):

Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning. In doing this, teachers ... nurture collaboration among students.

A fundamental social practice in *la vida cotidiana* of the rural classrooms in this study was cross-age interaction and collaboration. Traditional instructional models tend to emphasize the child as an individual, independence, and separation of the cognitive and social; however, rural Mexican classrooms like those in El Bosque and Montecito encouraged students to work together in various forms of cooperative learning. Students had opportunities to serve as teachers as well as collaborators. In contrast to individual and competitive achievement, academic success of groups and at times the entire class was emphasized. The students were accustomed to a highly social environment where they have specific individual and group responsibilities. Science teacher educators and science teachers could draw on these depictions of practices in rural Mexican classrooms to adapt and reconstruct social discourse structures in diverse classrooms to accomplish the types of cooperative social interactions that were typical in the classrooms of El Bosque and Montecito.

The NRC summary statement regarding the need for teachers of inquiry-based science to provide opportunities for learners to publicly communicate and justify their proposed explanations addresses the challenge of developing students' interactive social discourse practices. For example, teachers are called to foster students' "respect for the diverse ideas, skills, and experiences of all students" and facilitate "a shared understanding of rules of scientific discourse" (NRC, 2000: 23). In this regard, science teachers and researchers could examine the portraits of public performance evident in the rural Mexican classrooms that we studied to consider how to incorporate public performance social discourse structures into the daily life of all classrooms (e.g., reading aloud of *diarios*; holding class meetings run by students) that provide the kinds of opportunities students in El Bosque and Montecito have to hone their skills for respecting and responding to peers' ideas and feedback.

Finally, an important aspect of inquiry-based science teaching involves the use of community resources (NRC, 1996, 2000). In the Montecito and El Bosque students' lives, community was an integral component – whether community was bounded by the four walls of the classroom (i.e., their group of classmates) or the larger geographic community. Science teachers interested in implementing culturally responsive, inquiry-based science teaching seek ways of making explicit their belief of the importance and value of community in their students' lives and their own lives as well. They seek ways to support learners in inquiry-based science instruction by making use of available resources and using local funds of knowledge to make instruction directly relevant to their students' lives. The two, rural Mexican, school teachers' day-to-day use of community resources in science teaching could

provide ideas for teachers in more complex, multilayered, community settings about utilizing community resources to support effective science teaching and learning. An understanding of the two teachers' practices also yields insights about social discourse practices that could help students value and articulate their locally constructed knowledge of nature and naturally occurring events. These teachers saw the resident knowledge of their students as complementary to school science and situated on a continuum of people's search, description, and explanation of patterns of events in the universe (Good, Shymansky, & Yore, 1999). Such a pragmatic view of knowledge about nature and naturally occurring events allows and encourages students to cross borders between science, school, and home as they are approached.

All of this said, we certainly do not espouse that the classrooms in El Bosque and Montecito are typical of rural Mexican classrooms nor of Mexican classrooms in general. Neither do we wish to paint a simplistic picture of the promotion of social discourse practices that are instrumental to science learning and the development of science literacy. Lena and Alberto unquestionably faced challenges in the day-to-day operation of their classes. On the other hand, we do wish to counter the prevailing tendency to discuss issues of the teaching and learning of students from culturally diverse backgrounds from a *deficit* frame. Instead, we seek to approach issues of multiple discourses in teaching and learning from a frame that locates and teaches to the *strengths* that students bring to the classroom. Certainly whether students from rural Mexican classrooms move, for example, to urban Mexican classrooms or to suburban U.S. classrooms, they will encounter not only linguistic transitions but also cultural transitions (e.g., school culture, community culture). A more culturally responsive science classroom will accommodate interactional styles of learning in which students are used to making choices and having responsibility, as opposed to more traditional classrooms that remove or limit student responsibility. Culturally responsive science will be facilitated by teachers' knowledge of both linguistic and cultural contexts for students' and families' knowledge of nature and naturally occurring events. In short, culturally responsive science – and more generally, culturally responsive pedagogy – will incorporate sociocultural knowledge of the lives and experiences of the students for whom the pedagogy is being developed (Gay, 2002).

Culturally responsive pedagogy interrupts the complicity of traditional classroom teaching. It calls for teachers to unearth and make explicit their beliefs, assumptions, and attitudes about students from culturally diverse backgrounds. Research has demonstrated quite clearly that teachers hold beliefs about culturally diverse students based on characteristics such as race, culture, ethnicity, and language (Bryan & Atwater, 2002). Furthermore, these beliefs are sometimes not positive and often serve as a barrier to effective instruction. One belief held by practicing and prospective teachers that is most strongly supported by research is that students from culturally diverse backgrounds are academically less capable; thus, teachers construct simpler goals for their instruction. In turn, children from diverse backgrounds are often afforded less autonomy in the classroom, less opportunity to interact with one another, and most often required to passively receive their education (Olmedo, 1997; Solomon, Battistich, & Hom, 1996; Stevens & Palinscar, 1992; Valdés, 1996). This is in stark contrast to the learning environments and learning goals that are called for in science reform initiatives (e.g., NRC, 1996, 2000) and that we observed in the

classrooms of El Bosque and Montecito. Teachers like Lena and Alberto who hold positive beliefs about students' capability and success are teachers who create environments in which students have an opportunity to succeed (Ladson-Billings, 1994).

Finally, culturally responsive pedagogy calls for teachers to inquire into intellectually and socially significant issues about race, culture, and socioeconomics and to become more involved in learning about the complex sociocultural world in which diverse children construct knowledge outside of the classroom and prior to coming to their classrooms. For the educator, this means more than simply infusing multicultural activities about food, traditions, or handicrafts into the classrooms (Cochran-Smith, 1995: 495):

What we need ... is not better generic strategies for 'teaching multicultural education' or 'teaching for diversity' nor more lessons about basket making and other customs in non-Anglo cultures. Instead, ... we need ... ways for prospective teachers, experienced teachers, and teacher educators alike to work together in communities of learners – to explore and reconsider their own assumptions, understand the values and practices of families and cultures that are different from their own, and construct pedagogy that takes these into account in locally appropriate and culturally sensitive ways.

Many of the current resources available for English-speaking science educators teaching Latino and other immigrant students in the U.S.A. recommend active, inquiry-based methods and cooperative learning approaches (Ovando, Combs, & Collier, 2006) that build on the language and culture of the home (Garcia, 2001) and challenge students to develop critical thinking skills for problem solving (Cummins, 2000). What's missing in many of these recommendations is a vision of what these approaches might look like in the day-to-day life of elementary and secondary classrooms and how teachers might go beyond strategies such as Sheltered Science Instruction (Dobb, 2004) and the integration of second-language acquisition with science content (Fathman, Quinn, & Kessler, 1992). These strategies built on linguistic aspects of learning in a second language often overlook important social discourse practices (such as responsibility, autonomy, and public performance) that were cultural features of the rural Mexican classrooms in this study. Teacher educators preparing future science educators for effective teaching of Latino and other immigrant students might consider developing curriculum modules that examine and model ways to foster social discourse practices essential for science literacy and inquiry that reflect the social discourse practices found in immigrant students' home, community, and previous schooling experiences. To complement such modules, science teacher educators also might consider designing field experiences in diverse communities that could provide grounded, cross-cultural contexts in which prospective teachers are able to develop and enhance their skills for conveying science content in ways that are meaningful for diverse learners. Additionally, science teacher educators could also encourage preservice teacher inquiry in diverse students' communities, both in the U.S. and in countries of origin, to investigate social discourse practices that might be relevant for science teaching and learning. If science teachers are to reshape the sociocultural environments in which their students learn to be more resonant with inquiry-based teaching and learning, they must become knowledgeable in how to help students cultivate the sociocultural discourse practices involved in inquiry. Fundamentally, this requires *knowing* one's students and recog-

nizing the importance of culturally diverse students' antecedent schooling experiences.

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