Teaching Science to English Language Learners

Building on Students’ Strengths

Ann S. Rosebery and Beth Warren, editors
Contents

ABOUT THIS BOOK ix
ACKNOWLEDGMENTS x
INTRODUCTION xi
   Ann S. Rosebery and Beth Warren
ABOUT THE EDITORS xv

Part I: Teaching From Students’ Strengths

1. ESSAY: CREATING A FOUNDATION THROUGH STUDENT CONVERSATION 1
   Ann S. Rosebery and Cynthia Ballenger

2. A TEACHER’S PERSPECTIVE: SCIENCE TALKS 13
   Mary Rizzuto

3. ESSAY: USING STUDENTS’ CONVERSATIONAL STYLES 21
   Josiane Hudicourt-Barnes and Cynthia Ballenger

4. ESSAY: ENCOURAGING STUDENTS’ IMAGINATION 31
   Mark S. Ogonowski

5. ESSAY: USING EVERYDAY EXPERIENCE TO TEACH SCIENCE 39
   Beth Warren and Ann S. Rosebery

6. A TEACHER’S PERSPECTIVE: USING STUDENTS’ EXPERIENCE TO UNDERSTAND SCIENCE 51
   Renote Jean-François
Part II: Teaching Academic Language

7. ESSAY: WHAT IS ACADEMIC LANGUAGE? 57
   James Paul Gee

8. ESSAY: WHAT IS THE VOCABULARY OF SCIENCE? 71
   Catherine Snow

9. CASE STUDY: VOCABULARY 85
   Beth Warren

Part III: Learning More

10. ESSAY: WHAT IS CULTURE? 89
    Norma González

11. CASE STUDY: USING STUDENTS’ CULTURAL RESOURCES IN TEACHING 99
    Cathy Amanti, Norma González, and Luis Moll

12. A TEACHER’S PERSPECTIVE: WHAT IS CULTURE? 103
    Ana Vaisenstein

13. ESSAY: LEARNING A SECOND LANGUAGE 107
    Ellen Bialystok

14. CASE STUDY: USING TWO LANGUAGES TO LEARN SCIENCE 119
    Cynthia Ballenger

15. A TEACHER’S PERSPECTIVE: LEARNING A SECOND LANGUAGE 125
    Ana Vaisenstein

16. ESSAY: PROGRAMS FOR TEACHING ENGLISH LANGUAGE LEARNERS 129
    Fred Genesee and Donna Christian
17. A TEACHER’S PERSPECTIVE: PROGRAMS FOR TEACHING ENGLISH LANGUAGE LEARNERS 147
   Mary Rizzuto

18. ESSAY: CREATING CULTURALLY RESPONSIVE LEARNING COMMUNITIES 151
   Eugene E. García and Okhee Lee

19. A TEACHER’S PERSPECTIVE: CREATING CULTURALLY RESPONSIVE LEARNING COMMUNITIES 163
   Ana Vaisenstein

Part IV: Teaching All Students

20. ESSAY: WHAT IS EQUITY IN SCIENCE EDUCATION? 167
    Walter G. Secada

21. A TEACHER’S PERSPECTIVE: WHAT IS EQUITY IN SCIENCE EDUCATION? 183
    Mary Rizzuto

22. CONCLUSION: RECONCEPTUALIZING DIVERSITY IN THE SCIENCE CLASSROOM 187
    Beth Warren and Ann S. Rosebery

CONTRIBUTORS 191

INDEX 193
About This Book

The essays in this book are written by researchers dedicated to improving science education for English language learners. To make the essays as accessible and useful as possible, we have grounded them in two ways. First, case studies from actual classrooms bring the research to life and describe instances of teaching and learning. Second, reflections by teachers, entitled “A Teacher’s Perspective,” extend the ideas discussed in the essays by offering a classroom perspective.

The essays are organized from a classroom teacher’s point of view. “Part I, Teaching From Students’ Strengths,” begins in the classroom with a discussion of intellectual strengths that students bring to school from their everyday lives. It is composed of four essays that address the educational benefits of using students’ intellectual strengths as the foundation for science teaching and learning. Part II, “Teaching Academic Language,” moves to a discussion of academic language. It is composed of two essays that focus on issues related to learning to talk, read, and write science in school. Part III, “Learning More,” offers additional information on important issues for interested practitioners. It includes four essays that summarize current perspectives on culture, second-language acquisition, instructional programs, and culturally responsive classrooms for English language learners. Part IV, “Teaching All Students,” contains two essays that urge educators to think deeply and critically about the meanings and roles of equity and diversity in teaching science to English language learners.

The essays in this volume can be read in any order. For example, Walter Secada’s essay on equity in science education is located in Part IV, but some readers may wish to begin with it because of the big-picture view it provides. We hope that, taken as a whole, the ideas in this volume will shed light on some possible answers to questions readers are asking about teaching science to English language learners.
Acknowledgments

This volume was developed by the staff of the Chèche Konnen Center at TERC in Cambridge, Massachusetts. The Chèche Konnen Center is dedicated to improving opportunities to learn in science for children from communities historically underrepresented in the sciences. It conducts research on learning and teaching in urban classrooms, and on teacher inquiry as a form of professional development. (For more information, visit our website at: http://chechekonnen.terc.edu.)

The editors wish to thank all the contributors to this volume, who include Chèche Konnen Center staff as well as educational professionals from other institutions. The list of contributors can be found at the end of the volume. We are especially appreciative of Lori Likis’s thoughtful contributions as developmental editor. We also thank Dee Goldberg of the Spring Branch (Texas) Independent School District and Gail Paulin of the Tucson (Arizona) Unified School District and their colleagues for providing classroom examples. Authors Fred Genesee and Donna Christian wish to thank Beverly Boyson, Andrea K. Ceppi, Virginia Collier, Jana Echevarria, Claude Goldenberg, Elizabeth Howard, Jo-Anne Lau-Smith, William Saunders, Deborah J. Short, Wayne P. Thomas, and Lois Yamauchi for their contributions. Most importantly, the editors wish to thank the many teachers and students who were involved in the research reported in this volume.

Michael Klentschy, superintendent, El Centro School District, and Mercedes Duron-Flores and Elizabeth Molina-De La Torre, experienced teacher practitioners from Valle Imperial, California, reviewed and provided thoughtful comments on early drafts, as did Emmett Wright and Jean Vanski from the National Science Foundation (NSF). Also from NSF, Carole Stearns made valuable suggestions on the volume’s content and structure and, with Susan Snyder, provided unwavering support for it. Finally, the editors would like to thank Betty Smith, associate editor, NSTA Press, for her help in bringing the volume to publication.

The work reported in this volume was supported by: the National Science Foundation (Grants Nos. REC-9153961, REC-9453086, ESI-9555712, REC-0353341, REC-0106194, and ESI-0119732); the Department of Education, Office of Educational Research and Improvement through the National Center for Improving Student Learning and Achievement (Cooperative Agreement No. R305A60007) and Center for Research on Education, Diversity and Excellence (Cooperative Agreement No. R306A60001); the National Science Foundation, U.S. Department of Education, and National Institutes of Health (Grant No. REC-0089231); and the Spencer Foundation. Any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views or policies of the funding agencies.

Ann S. Rosebery
Beth Warren

x

National Science Teachers Association
Introduction

Can students learn science before they are proficient in English? Do students need to master basic skills before they can engage in scientific inquiry? Is concentrating on the specialized vocabulary of science the best way to help English language learners learn science? Can a student’s cultural background interfere with or support learning in science?

This book addresses these and other questions that are frequently asked by educators teaching science to English language learners. It offers a variety of voices in response. Through education-related research, classroom case studies, and the perspectives of classroom teachers, this volume offers valuable information for teachers who wish to reflect on, experiment with, and adapt their instructional practice to teach science to English language learners. Its aim is to support educators in their efforts to see linguistic and cultural diversity as a resource—rather than an obstacle—in the science classroom.

THE DILEMMAS EDUCATORS FACE

By 2030, children from homes in which a first language other than English is spoken will constitute approximately 40% of the school-age population in the United States (Thomas and Collier 2002). This shift is expected to happen in 15 states—including Arizona, California, Florida, Texas, and New York—by 2015 (Hochschild and Scovronick 2003). It has already taken place in several large urban school systems such as New York City, Miami, and Los Angeles, where half of the children in the public schools are immigrants or from immigrant families.

At the same time, schools in the United States are struggling to provide children from historically underserved populations with high-quality opportunities to learn in science and mathematics (NSF 2006). These children have limited access to

• rigorous, comprehensive science and mathematics programs, K–12;

• well-prepared, enthusiastic science and mathematics teachers; and,

• basic, up-to-date facilities, equipment, and resources, such as computers, laboratories, and textbooks.

Perhaps even more consequentially, children from historically underserved populations are judged as having low ability in science and mathematics at much higher rates than are children from white, middle-income families. One result is that science and mathematics programs in
the schools of children from historically underserved populations tend to put less emphasis on inquiry, problem solving, and active involvement and more emphasis on basic skills than do the science and mathematics programs in schools that serve middle-income children (August and Hakuta 1997; Garcia 2001; Oakes 1990; Oakes et al. 1990).

Teaching English language learners is challenging because, by definition, teachers are often interacting with students from linguistic and cultural backgrounds distant from their own. Many of us who speak English as a first language tend not to think about the dynamics that language and culture play in our daily lives. We live relatively unaware of how these dimensions figure into our daily experience. We may come closest to recognizing their potential impact on our lives when, for example, we struggle to read a book written in an unfamiliar style or cannot understand a doctor’s explanation because it includes technical language with which we are unfamiliar.

Sometimes the distance between a teacher’s experience and that of her students may obscure her sense of her students as thinkers and learners and inadvertently work against her best intentions to teach them. In an account of her experiences learning to cross cultural fault lines as the sole American teacher at a preschool serving Haitian immigrant children, Cindy Ballenger (1999, p. 3) expressed this challenge well.

I began with these children expecting deficits, not because I believed they or their background were deficient—I was definitely against such a view—but because I did not know how to see their strengths.

Teachers routinely face this dilemma: how to understand a child who uses language, whether English or another language, in ways that do not make sense to the teacher, that seem off topic, confusing, or somehow academically deficient. Teachers may find that they ask themselves questions like: Does the child understand what I am asking her to do? Is the child being rude or making a joke? Why is the child telling me a story about a bicycle hitting a pedestrian when I asked for an explanation of the pattern of speed of a toy car rolling down a ramp? What does the story have to do with constantly accelerating motion?

A premise of this book is that to teach science effectively to English language learners, teachers must learn to see the deep connections between their students’ language and cultural practices and the language and cultural practices of knowledge making in the sciences. Such insights form the foundation for effective teaching practices.

This book offers examples of classroom-based research that shed light on the depth of the connections between children’s diverse language and
Deep connections exist between students’ language and cultural practices and knowledge making in science.

cultural repertoires and those of the sciences, and we share examples of classroom practices in science that are designed to build directly on these connections.

Ann S. Rosebery
Beth Warren
Chèche Konnen Center
TERC

REFERENCES

About the Editors

Ann S. Rosebery is a codirector of the Chèche Konnen Center at TERC in Cambridge, Massachusetts. The mission of the center is to improve science teaching and learning for elementary and middle school children from communities historically placed at risk. Rosebery’s principal interests are identifying the intellectual, linguistic, and experiential resources that children from those communities bring to learning science and the related issues of teacher professional development. She conducts classroom-based research in close collaboration with teachers and has worked with school districts nationwide to establish programs of professional development that help teachers teach to the intellectual strengths of all children, with a special focus on those who are learning English.

Her work has been funded by the National Science Foundation, the U.S. Department of Education, the Ford Foundation, and the Spencer Foundation. She has taught elementary and middle school students as well as graduate level courses in psychology and education. She has a BA in psychology and education from Smith College, an MS in language and literacy from the University of Pennsylvania, and an EdD in human development from Harvard University Graduate School of Education. She is the author of numerous articles and books, including a video series, for both practitioner and scholarly audiences.

Beth Warren is also codirector of the Chèche Konnen Center, TERC, in Cambridge, Massachusetts, where she does research on learning and teaching as processes of intercultural navigation within and across academic literacies. For the past 20 years, in close collaboration with teachers and researchers at Chèche Konnen, she has worked at a) documenting the rich, varied sense-making practices that children from communities historically placed at risk use to understand scientific phenomena and how those practices connect in generative ways with the practices valued in scientific and other academic disciplines; b) designing innovative classroom practices that support children in deep and expansive meaning making in the sciences; and c) developing and studying forms of teacher professional inquiry that focus on learning to teach to the intellectual strengths of all children.

Over the years, she and her colleagues have received many grants from the National Science Foundation, the Spencer Foundation, the Ford Foundation, and the U.S. Department of Education, and have collaborated with several national research centers. The resulting work has been published in various journals and books. Warren has a BA in French language and literature from Wesleyan University, an EdM in reading and an EdD in human development from Harvard Graduate School of Education.
Chapter 18
Essay: Creating Culturally Responsive Learning Communities

Eugene E. García
Arizona State University
Okhee Lee
University of Miami

The population of the United States is more ethnically and racially diverse than ever, a fact particularly evident among young and school-age children. This presents today’s elementary schools—including teachers, administrators, and policy makers—with an enormous challenge: promoting educational equity in the classroom and educating all students in order to achieve high academic standards. How can educators best meet this challenge? The answer we propose in this essay is: Create responsive learning communities.

Responsive Learning Communities

As most educators and researchers agree, many students from culturally and linguistically diverse backgrounds in the United States have had unsuccessful schooling experiences. Their strengths and needs have not been recognized adequately in mainstream classrooms, particularly in mathematics and science.

To address these needs and meet the challenge of achieving high standards for all learners, we propose that educators consider creating responsive learning communities. This new pedagogy is based on respect for students’ values,
Many students from culturally and linguistically diverse backgrounds have had unsuccessful schooling experiences. Their strengths and needs have not been recognized adequately in mainstream classrooms, particularly in mathematics and science.

In this essay, we will explore the notion of responsive learning communities through a discussion of

- the importance of language and culture in learning and teaching,
- the importance of literacy development for learning in all disciplines, and
- the special challenges associated with teaching science to students from linguistically and culturally diverse backgrounds.

We conclude with a discussion of conceptual dimensions that characterize high-performing responsive learning communities.

Language and Culture in Learning and Teaching

Successful communication with students is essential to effective teaching. From a constructivist perspective, learning occurs when students build understanding by integrating prior knowledge with new information. From a theoretical perspective, teaching and learning environments that serve students well recognize that students spend their lives constructing knowledge both in and out of school. To build learning environments for students from diverse cultural and linguistic backgrounds that incorporate already-constructed knowledge, teachers must incorporate students’ first language as well as the cultural values from their home and community environments.

How do we, as educators, begin to understand how all these factors—language, values, prior knowledge, and academic goals—come together in the classroom? In describing our attempts to do so, the term constructivist is truly apt. A constructivist perspective is rooted in the notion that, for humans, knowing is a result of continual building and rebuilding. We come to understand a new concept by applying knowledge of previous concepts to the new information we are given. For example, to teach
negative numbers, a mathematics teacher can use the analogy of digging a hole—the more dirt you take out of the hole, the greater the hole becomes. In mathematics, the more one subtracts from a negative number, the greater the negative number becomes. But a teacher of mathematics cannot use this example with children who have no experience digging holes. It will not work. This theory of how people learn implies that continual revisions (or “renovations,” as an architect might say) are to be expected. Therefore, when we organize teaching and learning environments, we must recognize the relevance of students’ previous educational experiences and build our environments accordingly.

Embedded in a constructivist approach is the understanding that language and culture and the values that accompany them are likewise constructed in home and community environments. This approach acknowledges that children come to school already knowing many things and points out that children’s development and learning are best understood as the interactions of past and present linguistic, social, cultural, and cognitive constructions. Development and learning are enhanced when they occur in contexts that are socially, culturally, linguistically, and cognitively meaningful for the learner. These meaningful contexts provide a bridge from previous constructions to present constructions.

Meaningful contexts for learning have been notoriously inaccessible to children from culturally and linguistically diverse backgrounds, a situation that contributes to these children’s educational vulnerability. The culture transmitted by American schools is evident in forms of pedagogy, curricula, instruction, classroom configuration, and language practices that reinforce the mismatch between these students and their school experience. Aspects of this culture in a school are reflected in such practices as

- the exclusion from classroom curricula and activities of the histories, languages, experiences, and values of students from diverse linguistic and cultural backgrounds;

- tracking, which limits access to academic courses and justifies learning environments that do not foster students’ academic development, socialization, or perception of themselves as competent learners and language users; and

- lack of opportunities to engage in developmentally and culturally appropriate learning in ways other than by teacher-led instruction.

Although the cultural norms and language experiences that students from diverse backgrounds bring to the classroom may differ from those of the mainstream, research indicates that teachers who make
room for students’ first language and cultural experiences

- provide students with important cognitive and social foundations for learning English,
- produce a positive academic difference, and
- promote students’ participation and positive interpersonal relations in the classroom.

In addition, when teachers treat students’ cultural and linguistic knowledge as a resource rather than as a deficit, students are successful with the school curriculum. The more comprehensive the use of their first language, the greater the students’ potential to be academically successful.

To provide effective instruction for students learning English, teachers can use students’ first language to enhance their comprehension of instruction and encourage their students to use it for effective communication. To establish an instructional environment that builds on students’ resources and strengths in classroom instruction, teachers need

- to incorporate students’ cultural experiences from their homes and in the communities,
- to incorporate cultural artifacts and community resources in ways that are academically meaningful,
- to use culturally relevant examples and analogies drawn from students’ lives, and
- to incorporate instructional topics that examine issues from the perspectives of multiple cultures.

In essence, learning is enhanced when it occurs in contexts that are culturally, linguistically, and cognitively meaningful to students. It is through their first language and home culture that students create frameworks for new understandings.

**Beyond Basic Skills**

Literacy plays an important role in determining school-age children’s academic achievement. Learning to read and write in one’s first language is a complex task because it involves mastering skills specific to the written form of the language. The task is even more challenging for second-language learners or bilingual children. When these children do not have a foundation of literacy in their first language, learning to read and write in a second language like English can be overwhelming. (See Bialystok, p. 107, for more information on the challenges associated with learning to read a second language.) Recent educational research has attempted to identify the features of instruc-
tion and learning that serve students from culturally and linguistically diverse backgrounds well. We present a brief overview here.

August and Hakuta (1997) reviewed 33 studies and identified the following attributes as influential in creating optimal learning conditions that support high academic performance for students from linguistically and culturally diverse backgrounds:

• a supportive schoolwide climate,

• effective school leadership,

• customized learning environments,

• high levels of communication and coordination within and between schools,

• the inclusion of students’ first language and culture in instruction,

• a balanced curriculum that includes both basic and higher-order skills,

• explicit skill instruction,

• opportunities for practice,

• systematic student assessment,

• staff development opportunities, and

• home and parent involvement.

These features are in accord with the findings of other recent studies of effectiveness in programs specifically designed for linguistically and culturally diverse populations. Several of these come from California, which has one of the largest and fastest growing populations of school-age children from diverse backgrounds in the country. A study of early childhood care in California identified a set of principles that guides quality child care across a variety of settings serving families from linguistically and culturally diverse backgrounds (Chang et al. 1994). This study found that staff in these settings

• support the development of ethnic identity and antiracist attitudes among children,

• build upon the languages and cultures of students’ families and promote cross-cultural understanding among children,

• foster the preservation of children’s first language and encourage bilingualism among all children, and

• engage in ongoing assessments of their instruction and student learning.

A state-mandated study of exemplary schools in California serving students from diverse linguistic and cultural backgrounds identified several common key attributes (Berman 1992). These attributes included:
• flexibility—adapting to the diversity of languages and the special out-of-school needs of these students and their families, including their mobility;

• coordination—utilizing sometimes scarce and diverse resources, such as federal and state moneys and local community organizations, in highly coordinated ways to achieve academic goals;

• cultural validation—validating students’ cultures by incorporating materials and discussions that build on the linguistic and cultural aspects of their communities; and

• a shared vision—sharing a coherent sense of who the students are and what the educators hope to accomplish among the school’s principal, staff, instructional aides, parents, and community members.

A nationwide study summarized three large studies that investigated key factors in producing academic success for students from diverse linguistic and cultural backgrounds (Thomas and Collier 1995). Together, these studies cover more than a decade of data—with approximately 42,000 student records per school year—from five urban and suburban school districts in various regions of the United States. The studies focus on the length of time English language learners need to become academically successful in English. Three factors emerged as most significant in producing academic success:

• students’ use of their first language on a daily basis and the use of English for part of the day for cognitively complex academic instruction for as long as possible;

• use of current, best-practice approaches to teaching the academic curriculum, such as active learning, inquiry, and cognitively complex learning, using a student’s first language and English;

• changes in the social and cultural context of schooling, such as integrating English speakers and English language learners into the same class for instructional purposes, implementing developmental and two-way bilingual instructional goals, and transforming minority/majority relationships to ensure mutual respect for diverse languages and cultures.

Finally, schools in four states—Texas, Illinois, California, and Massachusetts—were identified as being particularly successful in achieving highly successful academic outcomes with English language learners (McLeod 1996). All of the schools focused on teaching students to read in their first language before teaching them to read in English. The goal of these schools was to promote mature de-
development of literacy in the students’ first language before transitioning students into English-language instruction. This approach resulted in a significant payoff: Students achieved levels of English-language development that allowed them to be successful when they were transitioned to classrooms in which instruction occurred in English.

Literacy development occurs through “an active process of creative construction,” (Lindfors 1985, p. 55). Today, literacy can no longer be interpreted merely as speaking, listening, reading, writing, and thinking in a given language. Many educators support a broader definition of literacy that includes critical-thinking and problem-solving abilities. In other words, the literate use of language is to problem solve and communicate—it includes the capacity for action, understanding, and insight. From this perspective we can see that, in the classroom context, children’s acquisition of literacy is actually entwined with their academic learning abilities. It is through the use of their first language that children come to learn the knowledge of various content areas, such as science, as well as learn how to use all forms of their language.

This body of research demonstrates that students’ first language and home culture should be used to promote literacy development in its broadest sense—as a tool to construct higher-order thinking processes and cognitive skills, and not only as a means to teach English and mainstream school culture. The development of literacy in students’ first language provides the social, cognitive, and linguistic foundation for academic success.

### Students From Diverse Backgrounds

All students bring into the science classroom ways of looking at the world that are formed by their personal environments. Students from diverse cultural and linguistic backgrounds have acquired everyday knowledge and primary discourses in their homes and communities, while they also learn science disciplines and discourse in school. To provide effective science instruction, teachers must face the challenge of ensuring that students from diverse backgrounds, who may have acquired diverse world views and had varied experiences, have access to and opportunities for acquiring science disciplines as practiced in the science community and in school science.

Science, as generally taught in American schools, has been defined in terms of Western tradition. However, it tends to be regarded as “culture free” rather than as a socially and culturally constructed discipline. Many educators assume that all students learn science when provided with opportunity. Critics concerned about science learning and achievement of students from diverse backgrounds, however, have
raised epistemological and pedagogical concerns about the nature of science, learning, and teaching as traditionally defined in the science community and school science. In addition, large-scale, standardized test scores in science clearly indicate significant achievement gaps among students from different language and cultural groups. A small body of research exists on promoting science learning and achievement with students from culturally and linguistically diverse backgrounds. More is needed if the goal of “science for all,” emphasized in current science education reform efforts, is to become a reality.

Science learning involves a two-part process that addresses scientific knowledge of the world and scientific habits of mind—doing so in a simultaneous manner (AAAS 1993). The development of scientific knowledge involves “knowing” science, or scientific understanding; “doing” science, or scientific inquiry; and “talking” science, or scientific discourse. The cultivation of scientific habits of mind includes scientific values and attitudes as well as the scientific world view. Because the science practices in school contexts in the United States reflect the norms and values of Western society, they are most familiar to students from the mainstream middle class. (See chapters by Hudicourt-Barnes and Ballenger, p. 21; by Ogonowski, p. 31; and by Rizzuto, p. 13, for further discussion of these and related issues.)

How might science learning be different for diverse groups of students? During the construction of scientific understanding, students from diverse backgrounds may need help bridging the gap between their relevant prior knowledge and experience in formal science instruction and the current classroom context. Building such a bridge allows them to integrate what they already know with what they are expected to learn. For example, a Hispanic teacher described how she used students’ first language and home culture in science instruction:

One example is taking temperature. I know now that I have to talk about the different measurements that you can get with the thermometer. Many students know that 38° means a fever, but some of them know it as around 100°. They don’t use terms like Celsius or Fahrenheit. They bring in these different experiences that we need to recognize.

Another example is all of the foods we cook at home. Cooking is important in feeding a family, and they relate to that well. Hispanics do a lot of cooking in our homes. All the foods we cook at home require a lot of boiling, and they see the evaporation. So when they have lessons that involve boiling and evaporating, they have something to build on to learn science. When we do the activity on boiling, we talk about
boiling frijoles (beans) and arroz (rice), things they relate to. When we measure the temperature of boiling water, we do it in both Celsius and Fahrenheit. Then they realize there are two systems of measuring the temperature. It is like speaking two languages, like bilingual.

Scientific inquiry is the most emphasized component of science learning in the National Science Education Standards (NRC 1996). Yet as an approach for enabling students to become independent learners, as they acquire knowledge by reflecting, predicting, inferring, and hypothesizing, it may pose challenges for many students who are from different cultural and language backgrounds. These students are often not versed in the concepts of “Western science,” the discourse of scientific argument, the culturally acceptable alternative explanations of natural phenomena, and the academically oriented English vocabulary that underpins scientific inquiry in U.S. schools. Limited-English-language proficiency and diverse cultural perspectives should not prevent students from engaging in meaningful scientific inquiry or from participating in formal and informal classroom instruction. Learning science is dependent on students’ ability to comprehend and communicate concepts and understandings. To promote science learning and achievement for students from culturally and linguistically diverse backgrounds, educators need to develop a pedagogy that merges subject-specific and diverse-oriented approaches (Lee 2002).

**Responsive Learning Communities**

A teaching and learning community that is responsive to the dynamics of social, cultural, and linguistic diversity—within the broader concerns for high-academic achievement—both requires and emerges from a particular schooling environment. Considerable work has been devoted to restructuring schools and changing the fundamental relationships among school personnel, students, families, and community members. Seldom, however, have these efforts focused on the unique influences that linguistic, social, and cultural dimensions may have on these relationships and structures.

The school environments that can support and nurture the development of responsive learning communities are not unlike those promoted by leading school-reform and restructuring advocates. We would further suggest, however, the incorporation of social-, cultural-, and linguistic-diversity concerns into the restructuring efforts. The resulting set of educational principles would support educators in addressing the challenges faced by schools that serve growing populations of students from diverse backgrounds.
The study of learning environments that we consider essential to the development of a responsive pedagogy has its origins in descriptive research of culturally and linguistically diverse schools. It is known as effective schooling research (Berman 1992; García 2001). The increasing social, cultural, and linguistic diversity represented by students in today’s public schools further challenges

<table>
<thead>
<tr>
<th>Table 1. Conceptual Dimensions for Addressing Cultural and Linguistic Diversity in Responsive Learning Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Schoolwide Practices</strong></td>
</tr>
<tr>
<td>• A vision defined by the acceptance and valuing of diversity</td>
</tr>
<tr>
<td>• Treatment of classroom practitioners as professionals, colleagues in school development decisions</td>
</tr>
<tr>
<td>• Collaboration, flexibility, enhanced professional development</td>
</tr>
<tr>
<td>• Elimination, gradual or immediate, of policies that categorize the educational experiences of students from diverse backgrounds as inferior or limiting for further academic learning</td>
</tr>
<tr>
<td>• Connection to surrounding community, particularly with the families of the students attending the school</td>
</tr>
<tr>
<td><strong>Teacher/Instructional Practices</strong></td>
</tr>
<tr>
<td>• Bilingual/bicultural skills and awareness</td>
</tr>
<tr>
<td>• High expectations of students from diverse backgrounds</td>
</tr>
<tr>
<td>• treatment of diversity as an asset to the classroom</td>
</tr>
<tr>
<td>• Ongoing professional development on issues of cultural and linguistic diversity and practices that are most effective</td>
</tr>
<tr>
<td>• Development of curriculum to address cultural and linguistic diversity, including:</td>
</tr>
<tr>
<td>• attention to and integration of students’ home culture and practices</td>
</tr>
<tr>
<td>• focus on maximizing student interactions across categories of English proficiency</td>
</tr>
<tr>
<td>• consideration of attention to academic performance, schooling prior to immigration to the United States</td>
</tr>
<tr>
<td>• regular and consistent attempts to elicit ideas from students for planning units, themes, and activities</td>
</tr>
<tr>
<td>• thematic approach to learning activities—with the integration of various skills, events, learning opportunities</td>
</tr>
</tbody>
</table>
educators to consider the theoretical and practical concerns that will ensure educational success for these students. Responsive learning communities must necessarily address issues of diversity in order to maximize their potential and sustain educational improvement over time. Table 1 summarizes the conceptual dimensions for high-performing, responsive learning communities (García 2001).

Conclusion

In summary, a responsive learning community framework recognizes that science learning, like all learning, has its roots in processes both inside and outside of school. The focus of such a framework is on responsive instructional engagement that encourages students to construct and reconstruct meaning. It also encourages students to reinterpret and augment their existing literacy and science knowledge within culturally relevant academic contexts.

In responsive learning communities, diversity is perceived and acted on as a resource for teaching and learning, rather than as a problem. A focus on what students bring to their schooling generates an asset- and resource-oriented approach, not a deficit- and needs-assessment approach. In such knowledge-driven, responsive, and engaging learning environments, students’ language, culture, and prior experience are seen as important resources for acquiring scientific and mathematical knowledge.

REFERENCES


Chapter 19
A Teacher’s Perspective: Creating Culturally Responsive Learning Communities

Ana Vaisenstein
Sumner Elementary School
Boston Public Schools

In their essay, “Creating Culturally Responsive Learning Communities,” p. 151, Eugene García and Okhee Lee begin with the idea that human beings construct knowledge by “applying knowledge of previous concepts to the new information that is presented.” They use this as a jumping-off point for a discussion of the idea of responsive learning communities, which are learning environments in which students’ out-of-school knowledge, values, experiences, beliefs, and histories are used as a foundation for learning academic subject matter. Ana Vaisenstein, a former first-grade teacher in a two-way bilingual school, shares her perspective.

Upon Reflection
What does it mean to use what students’ already know as the foundation for learning? And what can we, as teachers, do to help students show us what they know? García and Lee helped me reflect on my own classroom environment and look for new ways to use students’ out-of-school knowledge in my teaching, with an eye toward developing the kind of responsive learning community they discuss. As I read this
essay, I found myself thinking about my classroom and asking: What is already happening in my classroom that is like a responsive learning community? And what could be happening but is not? To explore how the idea of responsive learning communities might benefit me as a teacher, I decided to consider a project that my first graders and I conducted to learn what compost is and how it is done.

For many years, I was a first-grade teacher in a two-way, Spanish-English immersion school in Boston. To learn about composting, my students and I worked a plot in a local community garden. The garden was a block away from the school, a perfect extension of our classroom. Here, the children and I got involved in all aspects of gardening, from preparing the soil to harvesting the vegetables. This was a meaningful learning context for us. On the one hand, I was taking advantage of my students’ interest in nature, which was manifested in the many things they brought back to our classroom, from pebbles to buds, sticks, and snails. On the other hand, I was aware that gardening had the potential to allow the children to bring their out-of-school experiences into the classroom. Almost all of my students had taken care of plants or seen somebody else take care of plants. Everyone, therefore, had something to contribute to and learn from this project.

Toward the end of winter, I started an indoor compost to use later in the garden to enrich the soil. Some of the children knew what an outdoor compost was. They had gardens in their homes and their families composted. Others had no idea what a compost was and were composting for the first time, just like me. None of us had tried indoor composting, however, so we were learning about it together.

After a few weeks, the food we put into the compost bucket started to decompose and form a liquid. The instructions said to drain the “tea” and use it on plants. We did. The children got very excited and shared the many connections they saw to their everyday lives. Mario told us how his dad loved plants and put fertilizer on them. He said that the tea was like his Dad’s fertilizer. He was right. Now he was not only thinking about why his father used fertilizer, but he actually knew how to make it. Roselyn said that her mother told her that in Guatemala her family planted vegetables with abono (manure in Spanish) to make the plants stronger.

Reading García and Lee’s chapter prompted me to reflect on this experience with my students and see new things in it. I realized that, as we gardened, my students brought in aspects of their out-of-school knowledge, using both Spanish and English. This knowledge ex-
panded everyone’s understanding of composting and fertilizing and their relationship to plant growth. I also realized, however, that I could have done much more to take advantage of my students’ out-of-school knowledge and make it a central part of the project. It was evident that the children had a much wider range of experiences with growing seeds and tending plants than I had initially known. In addition, as I remembered that several of the children’s parents had offered help during the community garden cleanup days, I realized how much more their families could have contributed to our project. For example, they could have been our out-of-class experts, sharing their knowledge of gardening and plant culture from how to prepare the ground, how to use the tools, and what and when to plant to when to harvest.

This classroom experience was, I think, a small example of the kind of learning community that García and Lee describe. I now see, however, that focusing more on students’ out-of-school knowledge and involving their parents as “experts” would have added an entirely new dimension to our project. The children would have been proud and excited to have their parents act as teachers, and parents might have come to see the school as a more welcoming place. Such an exchange has the potential to improve, and possibly transform, the relationship between home and school for the children, the parents, and me, the teacher.

**In Summary**

The García and Lee essay highlighted for me the important role of children’s out-of-school experience in science teaching and learning and in making my classroom a responsive learning community. Children have much more to contribute to their own learning than I initially assumed. As a teacher, I am determined to trust the academic value of these experiences, and I am committed to drawing more actively and deliberately on my students’ and families’ knowledge. García and Lee have helped me understand what can be gained by allowing the children more latitude in shaping the learning that takes place in our classroom.
A
Abu-Lughod, Lila, 95
Academic language, 4, 57–69, 159
acquiring competence in, 115–116
conversational language and, 61–64
environment for learning, 67
elements of, 58–62
implications for teaching, 61–62
scientific writing, 58–60, 68
importance of, 57–58
multiple models of, 66
perspective reflected by, 66–67
preparing young children for, 62–64
purposes and forms of, 67–68
student acquisition of, 62–69 (See also
Vocabulary of science)
science vocabulary, 71–82, 112–114
students identifying as scientists and
use of, 64–66
syntax of, 114–116, 126–127
Achievement tests, 2, 22, 158, 169, 176, 190
Affirmative action, 178, 179
African Americans, 22, 23
Alamar, Kim, 138
Alphabetic systems, 110–111
orthography of, 110, 111, 126
rules for writing, 110–111
scripts for, 111
Amanti, Cathy, 99–102
American Association for the
Advancement of Science, 173
Amigos School (Cambridge, MA), 139–140
Anthropologists’ views of culture, 91–92, 95, 103
Archimedes’ principle, 107–108, 116
Audiotaping classroom discussions, 190
August, D., 155

B
Ball, Deborah, 49
Ballenger, Cynthia, xii, 1, 21, 119, 187, 189
Bateson, Mary Catherine, 97
Bay odyans, 24–27, 28
Benchmarks for Science Literacy, 178
Bialystok, Ellen, 107, 122, 125–127
Bilingual education, 6–7, 31, 34–35
developmental, 136–138
“early exit” programs, 133
English-as-a-second-language
instruction, 130–132
learning a second language, 107–116
teacher’s perspective on, 125–127
making choices for, 142–143
sheltered instruction for, 141
transitional, 132–135
using two languages to learn science, 119–123
Black, Sir James, 32, 33, 34
Boas, Franz, 91
Boston (MA) Public Schools, 51, 136, 163–165
Brodwin, Paul, 24
Buoyancy lesson, 18–19, 107, 112

C
Cambridge (MA) Public Schools, 39, 134
Caring about students, 171–172, 185
Certification in English-as-a-second-language instruction, 131
Chêche Konnen Center (Boston), 1, 21,
24, 28, 31, 39, 65, 85, 119, 187
Christian, Donna, 129
Classroom
documenting interactions in, 189–190
reconceptualizing diversity in, 1–2,
157–159, 187–190
use of imagination in, 34–37
Classroom talk, 1–11
language and cultural differences and, 1–2
objectivity and emotional detachment in, 4
other styles of, 3–4
science talk, 1, 4–11, 28, 29
typical IRE structure of, 2–3
Constructivist teaching approach, 152–153
Conversational styles of students, 21–30, 61–62, 114
academic language and, 61–64
allowing for multiple styles, 27–28
home- and school-based, 22–24
bay odyans among Haitian students, 24–27
language expectations at school, 21–22, 71–72
learning about, 29–30
Culturally responsive learning communities, 151–161
effective schooling research on, 160–161
language and culture in learning and teaching, 152–154
for literacy development, 22–23, 152, 154–157
rationale for, 151–152
school-wide practices for, 159, 160
for students from diverse backgrounds, 157–159
teacher/instructional practices for, 160
teacher’s perspective on, 163–165
using students’ cultural resources, 99–102, 154, 160–161
Culture, xii, 89–97
anthropologists’ views of, 91–92, 95, 103
current view of, 94–96
definitions of, 91–92
diversity in classroom, 1–2, 157–159, 187–190
in education, 92–94, 152–154
cultural deficiency, 93
cultural difference, 93
more recent concepts, 94
history of, 90–92
cultural determinism, 91–92
more recent concepts, 92
social evolution, 90–91
implications for educators, 96–97
importance in learning and teaching, 152–154
intelligence and, 89–90
materialist theory of, 92
mentalist theory of, 92
norms in American schools, 153–154
perspective based on, 89–90
processual notion of, 95–96
teacher’s perspective on, 103–105
using students’ cultural resources in teaching, 99–102, 154, 160–161
Curriculum participation of English language learners in, 167–170
standards-based, 168
weaving science talks into, 15, 17

D

DBE. See Developmental bilingual education
DeLeòn, Ramona, 139–140
Developmental bilingual education (DBE), 136–138
additive approach of, 137
case study of, 137–138
compared with transitional bilingual education, 137
goal of, 136–137
sheltered instruction for, 141
Dewey, John, 49
DiSchino, Mary, 39, 44, 133–134
Diversity of students, 1–2, 22, 157–158, 187–190
culturally responsive learning communities for, 157–159
using students’ cultural resources in teaching, 99–102, 154, 160–161
Documenting classroom discussions, 189–190
Dominguez, Colleen, 130–132

E

“Early exit bilingual education,” 133
Educational approaches for English language learners, 129–145
attributes of successful programs, 154–157
content and academic standards of, 130
decision making about, 167–170
developmental bilingual education, 136–138
English-as-a-second-language instruction, 130–132
making choices for, 142–144
needs of students and, 129–130
newcomer programs, 135–136
shared features of, 144
sheltered instruction, 140–142
teacher's perspective on, 147–150
transitional bilingual education, 132–135
two-way immersion, 138–140
Einstein, Albert, 4
ELLs. See English language learners
Embodied imagining, 33–34, 37
Emotional detachment, 4, 32
English-as-a-second-language (ESL) instruction, 130–132, 143
case study of, 131–132
integration with academic objectives of mainstream curriculum, 131
“pull-out” programs, 130–131
“push-in” programs, 132
sheltered instruction for, 132, 141, 142
teacher certification in, 131
teacher's perspective on, 147–150
English language learners (ELLs). See also Students
acquisition of academic language, 4, 57–69
areas with large populations of, xi
assessment of, 2, 22, 158, 169, 176, 190
attributes of successful programs for, 154–157
challenges in teaching, xii
challenges of learning science in a second language, 109–116
reading the passage, 110–112
understanding the sentences, 114–116
understanding the words, 112–114
decision making about participation in science curriculum, 167–170
IRE talk pattern with, 2–3
learning a second language, 107–116
teacher’s perspective on, 125–127
needs of, 129–130
number of, xi

programs for teaching, 129–145 (See also Educational approaches for
English language learners)
representation and stereotyping of, 176–177
socioeconomic background of, 1, 2
teachers’ expectations of, xii, 1–2

Equality in education, 175–176
Equity in science education, 167–180
achieving success in, 180
changing ideas of, 180
influence on decision making, 167–170
meanings of, 170–171, 183–184
caring, 171–172, 185
equality, 175–176
opposition to excellence, 177–178
representation, 176–177
social justice, 173–175, 179–180
socially enlightened self-interest, 172–173
other conceptions of, 178–179
recognizing complexity of, 180, 183
reductionist view of, 179
teacher’s perspective on, 183–185

Escalante, Jaime, 172

ESL programs. See English-as-a-second-language instruction

Everyday experience of students
use in science teaching, 39–49
case studies of, 44–48
research on, 42–44
teacher’s perspective on, 51–56
at work, 39–42
using students’ cultural resources in teaching, 99–102, 154, 160–161

Fairness, 173–175, 184. See also Equity in science education

Feynman, Richard, 4

Force and motion lesson, 39–40

Funds of Knowledge for Teaching Project (Arizona), 99–102

G

Gallas, Karen, 10, 27–28, 189
García, Eugene E., 151, 163–165
Gee, James Paul, 57

Geertz, Clifford, 92
Genesee, Fred, 129
Goddard, Robert, 4
González, Norma, 89, 99, 103, 104
Grammatical structure, 114–116, 126–127

H
Hakuta, K., 155
Hawkins, D., 49
Historically underserved student populations, xi–xii
Home-based talking styles, 22–24
bay odysans among Haitian students, 24–27
recognizing scientific value in, 28
Home visits, 100–101
Hudicourt-Barnes, Josiane, 21
Humor, 3

I
Imagination, 8–9, 31–38
in the classroom, 34–37
case study of, 34–36
value of, 36–37
encouraging students’ use of, 37–38
process of embodied imagining, 33–34, 37
in scientists’ work, 32–34
examples of, 33–34
sharing stories of, 38
Inequalities in education, 175–176
Innuit students, 89
Intelligence and culture, 89–90
IRE talk pattern, 2–3

J
Jean-François, Renote, 45–48, 51–56, 136
John Greenleaf Whittier School (Chicago), The, 137–138

K
Kamehameha Early Education Program (Hawaii), 23
Keller, Evelyn Fox, 4

L
Language
academic, 4, 57–69
assessments and, 22
challenges of learning science in a second language, 109–116
reading the passage, 110–112
understanding the sentences, 114–116
understanding the words, 112–114
conversational styles, 21–30, 61–62, 114
differences in classroom, 1–2
diversity of language practices, 22
expectations at school, 21–22, 71–72
importance in learning and teaching, 107–109, 152–154
innate capacity for acquisition of, 113
learning a second language, 107–116
teacher’s perspective on, 125–127
using two languages to learn science, 119–123
literacy development, 22–23, 152, 154–157
metalinguage, 68
perspective reflected by, 66–67
programs for English language learners, 129–145
developmental bilingual education, 136–138
English-as-a-second-language instruction, 130–132
newcomer programs, 135–136
sheltered instruction, 140–142
transitional bilingual education, 132–135
two-way immersion, 138–140
relationship between content and, 109
syntax of, 114–116, 126–127
vocabulary of science, 71–82, 112–114
Learning
about students, 52
about students’ conversational styles, 29–30
culturally responsive learning communities, 151–161
importance of language and culture in, 152–154
Learning a second language, 107–116
literacy development and, 154–157
teacher’s perspective on, 125–127
Learning science in a second language, 109–116
  reading the passage, 110–112
  understanding the sentences, 114–116
  understanding the words, 112–114
  using two languages to learn science, 119–123
  vocabulary acquisition, 71–82
Leballo, Amelia, 132
Lee, Carol, 23
Lee, Okhee, 151, 163–165
Lemke, Jay, 3
LEP (limited-English-proficient) students. See English language learners
Limited-English-proficient (LEP) students. See English language learners
Listening, 53
Literacy development, 22–23, 152, 154–157
  academic learning and, 157
  attributes of successful programs for, 155–156
  optimal conditions for, 155
  in students’ first language, 157
M
Macnamara, J., 108
Mathematics programs, xi–xii
McClintock, Barbara, 4, 8
Medicine and Morality in Haiti, 24
Metalanguage, 68
Minstrell, James, 42
Modeling, 32
Moll, Luis, 99
N
National Assessment of Education Progress (NAEP), 175
National Geographic, 58
National Research Council, 173
National Science Education Standards, 159, 178
National Science Resources Center, 7
Native Language Literacy Program (Boston), 51
Natural History, 58
Needham Science Center (Needham, MA), 13, 147, 183
Newcomer programs, 135–136, 143
  case study of, 136
  curricula and designs of, 135–136
  definition of, 135
  goals of, 135
  location of, 135
No Child Left Behind legislation, 105
Note taking on classroom legislation, 190
O
Objectivity, 4, 32
Observing students, 29
Ogbu, John, 94
Ogonowski, Mark S., 31
Orthography, 110, 111, 126
P
Paley, Vivian, 189
Passion for science, 4
Pertuz, Marcia, 7, 9–10, 139–140
Plant Growth and Development, 7
Plant growth lessons, 6–10, 31–32, 71–72, 85–87
Pothier, Suzanne, 85–87
Processual notion of culture, 95–96
“Pull-out” English-as-a-second-language instruction, 130–131
“Push-in” English-as-a-second-language instruction, 132
R
Reading, 110–112
  comprehension, 23
  literacy development, 154–157
  spelling rules and, 111–112
  writing systems and, 110–112
Rizzuto, Mary, 13, 147, 183
Rosebery, Ann S., 1, 39, 133, 187
S
Schaub, Elsa, 141–142
School(s)
  cultural norms in, 153–154
  language expectations at, 21–22, 71–72
learning science words at, 78–79
science practices in, 158
talking styles at, 22–27
tracking in, 153
“Science for all,” 158
Science literacy, 172–173
Science talk, 1, 4–11, 28, 29
benefits of, 17–20
benefits of participation in, 5
definition of, 4–5
enthusiasm generated by, 19–20
example of talk on plant growth, 6–10, 31–32
getting started with, 6, 10–11
as method of theoretical inquiry, 19
questions for, 5
scheduling time for, 5–6
teacher’s perspective on, 13–20
as a learner, 13–14
as a teacher, 14–17
teacher’s role during, 6, 10–11, 28
videotaping of, 16
weaving into curriculum, 15, 17
Science textbook writing, 60–61
Scientific inquiry, 158–159
Scientific knowledge, 81, 158
Scientific writing, 58–60, 68
Scientists
imagination in work of, 32–34
students identifying as, 64–66
students talking and thinking like, 79–81, 82
Scripts, 111
Secada, Walter G., 167, 183–185
Sharing time, 23
Sheltered instruction (SI), 51, 132, 140–142
applications of, 141, 142, 143
case study of, 141–142
language and content objectives of, 141
strategies for, 140–141
teacher’s perspective on, 147–150
Snow, Catherine, 71, 87
Social evolution, 90–91
Social justice, 173–175, 179–180
Socially enlightened self-interest, 172–173
Socioeconomic background, 1, 2
Spelling rules, 110, 111, 126
Spring Branch (Texas) Independent School District, 131–132
Stereotyping, 176–177
Stewart, Gloria, 130
Students. See also English language learners
acquisition of academic language by, 62–69
science vocabulary, 71–82
assessments of, 22, 158, 169, 176, 190
caring about, 171–172, 185
connections between language and cultural practices and science learning by, xii–xiii, 152–154
“cultural deficiency” of, 93
developing literacy of, 22–23, 152, 154–157
couraging use of imagination by, 37–38
hearing what they know, 53–55
historically underserved populations of, xi–xii
language and cultural diversity of, 1–2, 22, 157–158, 187–190
language expectations of, 21–22, 71–72
learning about, 52
observation of, 29
participation in science talks, 1, 4–11
self-identification as scientists, 64–66
talking and thinking like a scientist, 79–81, 82
using cultural resources of, 99–102, 154, 160–161
visiting homes of, 100–101
Syntactic structure, 114–116, 126–127

T
“Talk story,” 23
Talking Their Way Into Science, 10, 27
TBE. See Transitional bilingual education
Teachers
adopting a stance of inquiry, 189
certification in English-as-a-second-language instruction, 131
challenges facing, xii, 2
constructivist approach of, 152–153
couraging students’ use of imagination, 37–38
hearing what students know, 53–55
Index

U
Underachievement, 172

V
Vaisenstein, Ana, 103, 123, 125, 163
Videotaping classroom discussions, 190
Vocabulary acquisition, 112–114
  in bilingual children, 112–113
  rate of growth of, 113
Vocabulary of science, 71–82, 109
  classification of, 72–73, 82
  example of, 74
  continuum of familiarity with, 82
  English language learners’ challenges in understanding words,
  112–114
  importance of “inner-state” words, 77–78
  learning of, 75–79, 113–114
  case study of, 85–87
  at home, 75–77
  at school, 78–79
  talking and thinking like a scientist, 79–81, 82
  tier-one words, 72, 82
  tier-three words, 73, 74, 82
  tier-two words, 72–73, 82
  importance of, 73–75

W
Warren, Beth, 39, 85, 133, 187
Williams, Raymond, 90
Willis, Paul, 94
Wilson, E. O., 4
Woodrow Wilson Middle School (Boston), 51, 136
Writing
  literacy development, 154–157
  rules connecting units of speech to units of print, 110
  of science textbooks, 60–61
  scientific, 58–60, 68
  systems of, 110–111
  orthography for, 110, 111, 126
  scripts for, 111

instructional practices for culturally responsive learning communities, 160
learning about students, 52
perspective on creating culturally responsive learning communities, 163–165
perspective on culture, 103–105
perspective on equity in science education, 183–185
perspective on learning a second language, 125–127
perspective on programs for teaching English language learners, 147–150
perspective on science talks, 13–20
perspective on using students’ everyday experience to teach science, 51–56
reconceptualizing diversity in science classroom, 187–190
role during science talks, 6, 10–11, 28
use of students’ cultural resources by, 99–102, 154, 160–161
Theory-of-mind tasks, 80–81
Third International Mathematics and Science Study (TIMSS), 175
Tracking in schools, 153
Transitional bilingual education (TBE), 132–135, 143
  case study of, 133–135
  compared with developmental bilingual education, 137
  duration of, 133
  “early exit” programs, 133
  goal of, 132
  process of, 133
  sheltered instruction for, 141
Tucson (Arizona) Unified School District, 99, 141
Two-way immersion (TWI) programs, 138–140
  case study of, 139–140
  core features of, 139
  goals of, 138
  requirements for success of, 138–139
  sheltered instruction for, 141