Science Instruction for All:

Promoting Science and Literacy for Linguistically and Culturally Diverse Elementary Students

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Introduction

The United States continues in a trend of ethnic and racial population diversification, a fact that is particularly evident among young and school-age children. With the growing population of culturally and linguistically diverse students in today's elementary schools, promoting educational equity in the classroom and educating these diverse students to achieve high academic standards have become great challenges for teachers, administrators, and policymakers (National Research Council, 1999). As indicated in the literature, many of the culturally and linguistically diverse students in U.S. have unsuccessful schooling experience and their strength and needs may not be recognized adequately in the mainstream classrooms (Garcia, 2001). This is particularly the case in math and science (Lee and Fradd, 1998)

The present conceptual paper is an attempt to address issues of promoting science and literacy for linguistically diverse elementary students and outlines a specific approach to such an endeavor. Exploration of these issues will start first with a discussion of the importance of language and cultural in learning and teaching. Although there is a growing recognition among educators and researchers of the importance of students' home languages and cultures in learning and teaching, our knowledge base of how to make education accessible, meaningful, and relevant for diverse students is still limited (August and Hakuta, 1997). In the next section, we address the current understanding of literacy development. It should be noted that most of the research on literacy development with linguistically diverse students has been constrained to traditional approaches for enhancing specific reading and writing skills, rather than the development of literacy from a comprehensive perspective (Lee and

Fradd, 1998; Garcia, 2001). In the third section, there will be a discussion of science learning and its particular relevance to linguistically and culturally diverse students. In the last section, we will outline the specific aspects of a present research effort, Science Instruction for All (SIFA) in the San Francisco Unified School District. This new endeavor is part of collaboration with the University of Miami and their similar research activity in the Miami Dade County schools.

The importance of language and culture in learning and teaching

Successful communication with students is essential in effective teaching. From a constructivist perspective, learning occurs when the students construct understanding by integrating prior knowledge with new information. Theoretically, teaching and learning environments that serve students well recognize that students have and are continuing to construct knowledge in and out of school. Specifically, then, such an understanding calls for a learning environment that is responsive to the needs of linguistically and culturally diverse students incorporating already constructed knowledge, including their first languages and cultural values, in home and community environments (Cole and Cole, 2001; Garcia, 2001; Tharp & Gallimore, 1988).

How do we as educators begin to understand such a complex set of interactions? One framework for understanding is founded on the concept of "act psychology." First formulated at the end of the nineteenth century, the notion of act psychology proposes a model for human cognitive processes, or how we come to know. It focuses on the assertion that the mental functions of perceiving, remembering, and organizing—ultimately, knowing—are all acts of construction. It also asserts that what we know is closely related to the circumstances in which we come to know it.

The term “constructivist” really is an apt one. The constructivist perspective is rooted in the notion that for humans, knowing is a result of continual building and rebuilding. Our “construction materials” consist of give and take between the organization and content of old information and new information, processes of organizing that information, and the specific physical and social circumstances in which this all occurs. We come to understand a new concept by applying knowledge of previous concepts to the new information we are given. For example, in order to teach negative numbers, a math teacher can use the analogy of digging a hole—the more dirt you take out of the hole, the greater the hole becomes; the more one subtracts from a negative number, the greater the negative number becomes. But a math teacher cannot use this example with children who have no experience digging holes. It won’t work. As you can see, this theory of how the mind works 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 nature of those environments. As educators, we “build” teaching and learning environments out of what we know and how we come to know it. And we must continue to build. To ignore that is to discount the relevance of previous educational environments to the ones we are considering now.

Embedded in the constructivist approach to education is the understanding that language and culture, and the values that accompany them, are constructed in both home and community environments. This approach acknowledges that children come to school with some constructed knowledge about many things and points out that children’s development and learning is best understood as the interaction of past and present linguistic, sociocultural, and cognitive constructions (Cole and Cole, 2001). A more appropriate perspective of development and learning, then, is one that recognizes

that development and learning is enhanced when it occurs in contexts that are socioculturally, linguistically, and cognitively meaningful for the learner. These meaningful contexts bridge previous "constructions" to present "constructions."

Such meaningful contexts have been notoriously inaccessible to linguistically and culturally diverse children. On the contrary, schooling practices often contribute to their educational vulnerability. The monolithic culture transmitted by the US schools in the form of pedagogy, curricula, instruction, classroom configuration, and language dramatizes the lack of fit between the culturally diverse student and the school experience. The culture of the U.S. schools is reflected in such practices as:

a. The systematic exclusion of the histories, languages, experiences, and values of these students from classroom curricula and activities.
b. "Tracking," which limits access to academic courses and which justifies learning environments that do not foster academic development and socialization or perception of self as a competent learner and language user.
c. A lack of opportunities to engage in developmentally and culturally appropriate learning in ways other than by teacher-led instruction. (Garcia, 2001)

Although the culture norms and language experiences that diverse students bring to the class may differ from the mainstream, a few studies indicated that teachers' using of student's home language and consideration of students' cultural experiences while interact with students from diverse backgrounds will:

a. provide students important cognitive and social foundation for second-language learning (Garcia, Bravo, Dickey, Chun, Sun-Iminger, In Press);
b. produce a positive academic difference (August & Hakuta, 1997); and,
c. promote students' participation and positive interpersonal relations in

the classroom (Au & Kawakimi, 1994; Trueba & Wright, 1992).

In addition, when teachers use and leverage student cultural and linguistic knowledge as a resource rather than as deficit, then students are more able to access the school curriculum (Valenzuela, 1999; Cummins, 2000). The more comprehensive the use of the home language, the greater the potential will be for linguistically diverse students' to be academically successful (Miramontes, Nadeau, & Commins, 1997).

How to provide effective instruction for students from diverse backgrounds? While considering students' language backgrounds, teachers need to use student's home language as appropriate to enhance the students' comprehension of instruction and encourage students to use their home language to communicate effectively (Lee & Fradd, 1998). For establishing cultural congruence in the instruction, teachers need to incorporate students' cultural experiences and lives at home and in the community, use cultural artifacts and community resources, use culturally relevant examples and analogies drawn from students' lives, and consider instructional topics from the perspectives of multiple cultures. In essence, learning is enhanced when it occurs in contexts that are culturally, linguistically, and cognitively meaningful and relevant to the students. It is through their first languages and home cultures that students create frameworks from new understandings.

Literacy development: beyond basic skills

Literacy plays an important role in determining school-aged children's academic achievement. The ability to read and write in one language may not be

easily acquired for young language user because it involves mastering skills that are specific to the written language. The task is even more challenging for second language learners or bilingual children. For students whose native language is not English, the process of literacy development in English can be particular difficult if they did not bring to the learning process a foundation of literacy in their other language.

The growth of literacy, as well as language, is through "an active process of creative construction" (Lindfors, 1985, p. 55). Today, literacy can no longer be interpreted as merely 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, it is "the literate use of language is to problem-solve and communicate-it includes the capacity for action, understanding, and insight" (Calfee, 1995, p. 55). 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 language that children come to learn the knowledge of different content areas as well as learn how to use all forms of their language.

While applying the above perspective on promoting culturally and linguistically diverse students' literacy development, it has become clearer that students' native language and home culture should not be used only as a means to learn English and mainstream school cultural but also as a tool to construct higher-order thinking process and cognitive skills. The development of literacy in student's native language provides the social, cognitive, and linguistic foundation for academic success.

Science learning for diverse students

Science, as generally taught in school, bas been generally defined in terms of Western tradition (American Association for the Advancement of Science, 1989, 1994; NRC, 1996) and tends to viewed as a set of objective and universal facts, rules, and procedures, it is often regarded as "cultural free" and not as a socially and culturally constructed discipline (Banks, 1993; Peterson & Barnes, 1996). Many assumed that all students would learn science when provided with opportunity.

However, critics from a diversity perspective 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 ethnolinguistic groups (National Science Foundation, 1994). There is little research available about promoting science learning and achievement with culturally and linguistically diverse students, even though the goal of "science for all" has be emphasized in current science reform (August & Hakuta, 1997).

All students bring into the science classroom their ways of looking at the world that are formed by their environments and personal environments (Driver, Asoko, Leac, Mortimer, & Scott, 1994). Students from diverse cultural and languages have acquired everyday knowledge and primary discourse in their homes and communities, while they also learn science disciplines and discourse in school. To provide effective science instruction, teachers face the challenges to ensure diverse students, who may have acquired different world views and science experience, to have access to and opportunities for acquiring the nature

of science disciplines as practiced in the science community and school science.

According to science education standards documents (AAAS, 1989, 1993; NRC, 1996), science learning involves a two-part process "to acquire both scientific knowledge of the world and scientific habits of mind at the same time" (AAAS, 1989, p. 190). The development of scientific knowledge involves "knowing" science (i.e., scientific understanding), "doing" science (i.e., scientific inquiry), and "talking" science (i.e., scientific discourse). The cultivation of scientific habits of minds includes scientific values and attitudes, as well as the scientific worldview. Because the science practices in school context reflect the thinking of Western society, the norms and values of science are more familiar to students from the mainstream middle-class than to students from diverse languages and cultures (Eisenhart, Finkel, & Marion, 1996; Lee & Fradd, 1998).

How science learning may be different with diverse groups of students? For example, during the construction of scientific understanding, students from diverse background may not have relevant prior knowledge and experience to successfully integrate what they have already know with what they are expected to learn. With regard to scientific inquiry, the most emphasized component of science learning in the National Science Education Standards (NRC, 1996), the approaches for enabling students to become independent learners as they acquire knowledge by reflecting, predicting, inferencing, and hypothesizing may poses challenges for many students from different cultures and language backgrounds (Casteel & Isom, 1994; Westby, 1995). The limited language proficiency and different cultural values can prevent diverse students to engage in meaningful science inquiry and to participate in formal and informal classroom discussion based on a shared understanding of rules of scientific discourse.

Learning science is dependent on students' ability to comprehend and communicate concepts and understandings (Fradd & Lee, 1998). To promote science learning and achievement of culturally and linguistically diverse students, educators need to develop a pedagogy merging subject-specific and diverse-oriented approaches (Lee, in press).

In sum, the discussion on the importance of language, culture, and literacy development and science learning for diverse students provides us foundations to developing culturally responsive curriculum and to prepare science teachers to integrate science and literacy with students' language and cultural experiences to promote both students' academic achievement and cultural identities.

Science Instruction for All: A Responsive Learning Community Project

This specific study directly explores an instructional intervention aimed at promoting achievement and equity in science and literacy, particularly focusing on science inquiry, for linguistically diverse as well as mainstream students. The study builds on a broader conceptual framework recognizing the linguistic and cultural assets and related resources that accompany students to the learning of science. This new pedagogy is one that redefines the classroom as a community of learners in which speakers, readers, and writers come together to define and redefine the meaning of the academic experience. It might be described by some as pedagogy of empowerment, by others as cultural learning, and others as a cultural view of providing instructional assistance / guidance. In any case, it argues for the respect and integration of the students' values, beliefs, histories, and experiences and recognizes the active role that students must play in the learning process. It is therefore a *responsive pedagogy*, one that encompasses practical, contextual, and empirical knowledge and a "world view" of education

that evolves through meaningful interactions among teachers, students, and other school community members. This responsive set of strategies expands students' knowledge beyond their own immediate experiences while using those experiences as a sound foundation for appropriating new knowledge.

Of course, 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. While considerable work has been devoted to restructure schools and change the fundamental relationships that exist among school personnel, students, families, and community members, seldom have these efforts included attention to the unique influences of the linguistic and sociocultural dimensions of these same relationships and structures. The environments that potentially support and nurture the development of responsive learning communities are not unlike those promoted by leading school reform and restructuring advocates; however, we further suggest that the incorporation of social, cultural, and linguistic diversity concerns creates a set of educational principles and dimensions that are more likely to address the challenges faced by schools that must attend to the needs of growing populations of diverse students.

Responsive Learning Communities. The study of learning environments that we consider essential to the development of a responsive pedagogy has its origins in descriptive research of linguistically and culturally diverse schools know as "Effective Schooling" research (Garcia, 2001). The focus on the social, cultural, and linguistic diversity represented by students in today's public schools further challenges us to consider the theoretical and practical concerns relative to

ensuring educational success for diverse students. That is, responsive learning communities must necessarily address issues of diversity in order to maximize their potential and to sustain educational improvement over time. To further examine this challenge, Table 2 summarizes the conceptual dimensions for high performing responsive learning communities.

Table 2. Conceptual Dimensions of Addressing Cultural and Linguistic Diversity in Responsive Learning Communities

School-wide Practices
• A vision defined by the acceptance and valuing of diversity--Americanization is NOT the goal • Treatment of classroom practitioners as professionals, colleagues in school development decisions • Characterized by collaboration, flexibility, enhanced professional development • Elimination (gradual or immediate) of policies that seek to categorize diverse students thereby rendering their educational experiences as inferior or limiting for further academic learning-- • Reflection of and connection to surrounding community--particularly with the families of the students attending the school
Teacher/Instructional Practices
• Bilingual / bicultural skills and awareness • High expectations of diverse students • Treatment of diversity as an asset to the classroom • Ongoing professional development on issues of cultural and linguistic diversity and practices that are most effective • Basis of curriculum development to address cultural and linguistic diversity: 1. Attention to and integration of home culture / practices 2. Focus on maximizing student interactions across categories of English proficiency, academic performance, schooling prior to immigration to US, etc. 3. Regular and consistent attempts to elicit ideas from students for planning units, themes, and activities 4. Thematic approach to learning activities--with the integration of various skills, events, learning opportunities 5. Focus on language development through meaningful interactions and communications versus on grammatical skill-building that is removed from its appropriate context

In summary, the present study, utilizing a Responsive Learning Community framework, recognizes that science learning has its roots in processes both out-of-school and in school. Its foci is on responsive instructional engagement that encourages students to construct and reconstruct meaning and to seek reinterpretations and augmentations to past knowledge regarding literacy and

science within compatible and nurturing schooling contexts. Diversity is perceived and acted on as a resource for teaching and learning instead of a problem. A focus on what students bring to the schooling process generates a more asset/resource-oriented approach versus a deficit/needs assessment approach. Within this knowledge-driven, responsive and engaging learning environment, skills are tools for acquiring knowledge, not a fundamental target of teaching events.

Methodologically, the research uses a longitudinal design with teachers for a 3.5-year period and students for a 2-year period. The process and impact of the intervention on teacher change and student achievement in the context of the state and district polities will be examined. Limited amount of teacher and student data from state-wide assessments in reading, writing, mathematics, and/or science will be available for comparison purposes between the participating schools and comparable schools as well as between the participating schools and district-wide results. Two levels of intervention will be offered: (a) teacher professional development provided by the research and (b) instructional process provided by the teachers for their students. The research addresses the following questions:

1. What are students' developmental trajectories in conducting science inquiry by English primary language and linguistically diverse elementary students?
    a. How do students learn to conduct science inquiry with less teacher and/or peer scaffolding?
    b. How do students learn to conduct more complex inquiry including (a) experimentation involving more than one variable and (b) evidence in support of theories.

2. What is the process of instructional intervention as teachers provide effective scaffolding by considering (a) the nature of science and literacy with students' language and cultural experiences and (b) the teacher explicit to student exploratory continuum?
3. What is the impact of the instructional intervention on
    a. teacher change,
    b. student achievement, and,
    c. the relationship between teacher change and student achievement?
4. How do state and district policies influence the implementation of the intervention including:
    a. local / district policies (standards, assessments, desegregation),
    b. state policies (accountability, LEP), and,
    c. federal policies (Title I, Title VII, desegregation)?

Research sites and participants

The research includes grade 3 through 5 elementary students and their teachers at six school sites in each of two school districts, including Miami, Florida, and San Francisco, California. The student and teacher participants represent diverse ethnolinguistic groups, including bilingual Hispanic / Latino, bilingual Haitian, bilingual Asian American, and monolingual English-speaking students in inner city and suburban settings.

Research implementation and instruments

To address the research questions, the research implementation includes gathering data in three domains: (a) student achievement, (b) teacher development, and (c) classroom instruction. The instruments utilized to gather data are aligned for inspection in Table 1.

Table 1. Overview of Research Questions and Data Sources

Research Questions	Data Sources
Students/Learning	
1. What are students' developmental trajectories in conducting science inquiry by English primary language and linguistically diverse elementary students? d. How do students learn to conduct science inquiry with less teacher guidance and/or peer scaffolding? e. How do students learn to conduct more complex inquiry including (a) experimentation involving more than one variable and (b) evidence in support of theories?	Student Assessments • Unit Tests • NAEP/TIMSS Tests • Writing Samples in Science (Alternative Assessments, Rubric/Standards Based) • Elicitations (Alternative Assessments, Rubric/Standards Based) • Classroom Observations • Teacher Judgment (Rubric/Standards Based, LALAR)
Teachers/Instruction	
2. What is the process of instructional intervention as teachers provide effective scaffolding by considering: a. the nature of science and literacy with students' language and cultural experiences, and b. the teacher explicit to student exploratory continuum?	Classroom Observations Teacher Focus Group Interviews Teacher Individual Interviews Teacher Surveys
Teachers and Students	
3. What is the impact of the instructional intervention on: a. teacher change, b. student achievement, c. the relationship between teacher change and student achievement?	Classroom Observations Teacher Focus Group Interviews Teacher Individual Interviews Teacher Surveys Student Assessments
Policy	
5. How do policies influence the implementation of the intervention? a. local/district policies (standards, assessments, desegregation), b. state policies (accountability, LEP) c. federal policies (Title I, Title VII, desegregation)	Teacher Surveys Teacher Interviews Documents and records

Instruction units. Instruction will focus on two units at each grade level,

including measurement and change of states of matter for grade 3, the water cycle and weather for grade 4, and the ecosystem and the solar system for grade 5. Each unit is designed for 2-3 months through three hours of instruction a week.

All the units are correlated with the national standards in science and literacy and consistent with the goals of the research by considering students' language and cultural experiences and the teacher explicit and student exploratory continuum. Examples of students' language and cultural experiences are provided in the teacher's guide. Moreover, within each unit, earlier lessons are more structured, whereas later lessons are more open-ended to encourage student exploration. Among the units, later units are more complex in both science concepts and inquiry than earlier ones.

Teacher professional development. Because the study involves a wide range of teachers with different language, culture, and science backgrounds, the professional develop should consider teachers' needs and strengths, including (a) those who have an understanding of students' language and culture but lack science knowledge, (b) those who have science knowledge but lack an understanding of students' language and culture, (c) those who have an understanding in both areas, and (d) those who lack an understanding in both areas. This information will provide insights about the areas of improvement with teachers, the process of teacher change, and student outcomes in terms of academic achievements and cultural identity.

Collaboration between the teachers and project personnel will be critically important in sharing insights, reflections, and suggestions. Professional development activities will occur through regular whole group meetings, school-level activities, and individual teachers. Each year, teachers from all school sites

will share experiences and insights across grade levels and language groups at 5 full-day whole group meetings (2 summer days and 3 school days). We will also meet with teachers at each school site to address specific needs and concerns. Moreover, after classroom observation, we will briefly interview teachers to gather feedback and insights about the lessons.

Classroom instruction. To provide effective instructional scaffolding for diverse students, teachers consider students' language and cultures as well as science and literacy. To make science and literacy meaningful and relevant, teachers need to understand culturally based interaction and communication patterns with their students. For example, teachers need to recognize whether the interaction patterns of their students are large group or individual exchanges, collaborative or individual interactions, and respect for authority or independent.

In relating science and literacy to students' language and cultural experiences, teachers recognize when these areas may be incompatible and help students resolve conflicts between the nature of academic disciplines and cultural expectations.

While considering students' languages and cultures, teachers will focus on promoting science inquiry. The explicit to exploratory continuum will be a function of students' cognitive and cultural needs and the demands of science tasks. Teachers will emphasize three components of inquiry instruction. First, they will assist students in the five aspects of science inquiry—(a) generate questions, (b) design investigations and plan procedures, (c) carry out the investigations, (d) analyze and draw conclusions, and (e) report findings. Second, they will assist students to take initiative, gradually expand, and finally conduct inquiry independently. Finally, they will assist students in more complex inquiry

tasks, such as experimentation involving more than one variable.

Instruments with teachers. The instruments for classroom observations, interview, and questionnaire measure teachers' knowledge, beliefs, and practices in establishing instructional congruence and promote science inquiry. The instructional congruence scale examines the degree to which the teacher integrates and promotes: (a) students' languages and cultures, (b) science learning, and (c) literacy development. The inquiry continuum scale examines the degree to which: (a) the teacher or students dominate the inquiry process and (b) the teacher progresses from explicit instruction to student exploratory inquiry.

Instruments with students. The instruments are designed to assess students' knowledge of science and literacy. At each grade level, two science tests measure: (a) key science concepts an big ideas of patterns, systems, and models and (b) science inquiry using more structured inquiry tasks and more open-ended inquiry tasks in which students generate questions, design investigations, and plan procedures. Prompts for expository writing samples are used as a measure of literacy. Scoring rubrics for the science tests and writing have been developed.

Summary

The Science Instruction For All draws on a set teaching and learning principles particularly relevant to linguistically and culturally diverse students of the United States (Garcia, 2001). This paper presents a conceptual framework for and an overview of the Science Instruction for All efforts as a part of the Responsive Learning Communities project, a multi-year school reform effort multilingual urban elementary schools. This education endeavor is a collaboration between teachers, district personnel, and university researchers. Through our work, we aim to

reform literacy and science instruction in bilingual and non-bilingual classrooms serving all students. The paper provides (a) the theoretical framework guiding our activities, (b) our research questions, (c) our research methodology, and, (c) our plans for utilizing that methodology to answer those questions. In understanding the inter-relationship between linguistic and cultural diversity, and science learning, we continue to contribute significantly to our knowledge base regarding diverse theories of language, learning, thinking, teaching, and culture. Moreover, we expect to expand our specific educational knowledge base regarding the intersection of learning in the content areas with a focus on science inquiry. The growing ethnic and linguistic diversity of our students has led us to consider an interdisciplinary study of linguistic, psychological, and social-cultural domains with regard to effective instructions for all students. It is this complex set of understanding that educators must depend upon when addressing teaching and learning in today's diverse classrooms.

References

American Association for the Advancement of Science (AAAS). (1989). Science for all Americans. New York: Oxford University Press.

American Association for the Advancement of Science (AAAS). (1993). Science for all Americans. New York: Oxford University Press.

August, D., & Hakuta, K. (Eds.) (1997). Improving schooling for language-minority children: A research agenda. Washington, DC: National Academy Press.

Banks, J. (1993). Multicultural education: Historical development, dimensions and practice. In L. Darling-Hammond (Ed.), Review of Research in Education.

Casteel, C. P., & Isom, B. A. (1994). Reciprocal processes in science and literacy learning. The Reading Teacher, 47, 538-545.

Cole, M. (1996). Cultural psychology: A once and future discipline. Cambridge, MA: Belknap Press of Harvard University Press.

Cole, M. & Cole, S. R. (2001). The development of children. New York, NY: Worth Publishers.

Diaz, S., Moll, L. C., & Mehan, H. (1986). Sociocultural resources in instruction: A context-specific approach. In Bilingual Education Office (Ed.), Beyond language: Social and cultural factors in schooling language minority students (pp. 197-230). Los Angeles: Evaluation, Dissemination, and Assessment Center, California State University.

Driver, R. Asoko, H. Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. Educational Researcher, 23, 261-295.

Eisenhart, M., Finkel, E., & Marion, S. F. (1996). Creating the conditions for scientific literacy: A re-examination. American Educational Research Journal, 33, 261-295.

Garcia, E. (2001) Student cultural diversity: Understanding and meeting the challenge. Boston, MA: Houghton Mifflin.

Garcia, E., Bravo, M. A., Dickey, L. M., Chun, K and Sun-Iminger, X. (In Press) Rethinking school reform in the context of cultural and linguistic diversity: Creating a responsive learning community-A case study. In L. Minaya-Rowe (Ed.), Research in Bilingual Education.

Heath, S. B. (1981). Towards an ethnohistory of writing in American education. In M. Farr-Whitman (Ed.), Variation in writing: Functional and linguistic cultural differences (Vol. 1, pp. 225-246). Hillsdale, NJ: Lawrence Erlbaum.

Lee, O., & Fradd, S. H. (1998). Science for all, including students from non-English language backgrounds. Educational Researcher, 27, 12-21.

Lindfors, J. W. (1985). Oral language learning: Understanding the development of language structure. In a Jaggar & M. T. Smith-Burke (Eds.), Observing the language learner (pp. 41-56). Newark, DE: International Reading association.

Miramontes, O., Nadeau, A., & Commins, N. (1997). Linguistic diversity and effective school reform: A process for decision making. New York, NY: Teachers College Press.

Moll, L (May, 2001). Funds of knowledge: Bilingualism and cultural as specific assets in schooling. Language Minority Research Institute Conference, University of California, Los Angeles.

National Research Council. (1999). Improving student learning. Washington, DC: National Academy Press.

National Research Council. (1996). National science education standards. Washington, DC: National Academy Press.

Peterson, P. L., & Barnes, C. (1996). Learning together: The challenge of mathematics, equity, and leadership. Phi Delta Kappan, 77, 485-491.

Scribner, S., & Cole, M. (1981). The psychology of literacy. Cambridge: Harvard University Press.

Wertsch, J. V. (1991). Vygotsky and the social formation of the mind. Cambridge, MA: Harvard University Press.

Westby, C. E. (1995). Cultural and literacy: Frameworks for understanding. Topics in Language Disorders, 16, 50-66.

Vol. 19. (pp. 3-49). Washington, DC: American Educational Research Association.