

Review of Educational Research

<http://rer.aera.net>

Teaching English Language Learners in the Content Areas

Joy Janzen

REVIEW OF EDUCATIONAL RESEARCH 2008; 78; 1010

DOI: 10.3102/0034654308325580

The online version of this article can be found at:

<http://rer.sagepub.com/cgi/content/abstract/78/4/1010>

Published on behalf of



American
Educational
Research
Association

<http://www.aera.net>

By



<http://www.sagepublications.com>

Additional services and information for *Review of Educational Research* can be found at:

Email Alerts: <http://rer.aera.net/cgi/alerts>

Subscriptions: <http://rer.aera.net/subscriptions>

Reprints: <http://www.aera.net/reprints>

Permissions: <http://www.aera.net/permissions>

Teaching English Language Learners in the Content Areas

Joy Janzen

Stony Brook University

This review examines current research on teaching English Language Learners (ELLs) in four content area subjects: History, math, English, and science. The following topics are examined in each content area: The linguistic, cognitive, and sociocultural features of academic literacy and how this literacy can be taught; general investigations of teaching; and professional development or teacher education issues. The article summarizes key findings in the literature, examining trends and discontinuities across the different content areas, and concludes with implications for teaching and suggestions for further research.

KEYWORDS: English language learners, literacy, instruction, content area, mainstream teachers.

According to the most recent Census data, children of immigrants account for 20% of the population of U.S. schools (Fix & Passel, 2003). This figure represents a substantial increase over the past 30 years; in 1970, just over 6% of the school population fell into this category (Fix & Passel, 2003). Although not all children of immigrants are English Language Learners (ELLs), recent data provided by the individual states show that many of them are: 10.5% of U.S. public school students have been identified as ELLs (National Clearinghouse for English Language Acquisition FAQ, November, 2006b).

A discouraging aspect of the rapidly increasing presence of ELLs in American schools is that these students are at high risk for academic failure (Ruiz-de-Velasco, Fix, & Clewell, 2000). For example, in 2000, the dropout rate for Latino/Latina youth, who comprise the majority of ELLs, was 22.4%. This rate is more than twice the national average, though this figure masks substantial variation in terms of national origin and generation of residence in the United States (National Center for Education Statistics, 2007; Pew Hispanic Center, 2004). In recent National Assessment of Educational Progress (NAEP) results, a large majority of ELLs scored below the basic level in almost all categories of achievement, including reading, writing, history, science, and mathematics. Moreover, they did so at all grades tested—4th, 8th, and 12th (National Center for Education Statistics, 2005). In a 5-year study examining the efficacy of different types of school programs offered to ELLs, Thomas and Collier (2001) found that most types failed to bring

the students to average levels of achievement on standardized tests of reading; this study looked at the school records of over 210,000 students across the country.

The causes of academic failure or stress are clearly multidimensional, ranging from institutional practices such as academic tracking (Callahan, 2005; Sharkey & Layzer, 2000) to students' level of first-language literacy to poverty. One critical issue, however, is teachers who are not prepared to work with non-native English speakers. A recent national survey determined that a high proportion of teachers, 41%, have ELLs in their classes, but only 12.5% of those teachers had had 8 or more hours of training in the previous 3 years on how to assist them (National Center for Education Statistics, 2002). A smaller-scale project reached similar conclusions: Byrnes, Kiger, and Manning (1998) queried approximately 200 practicing teachers in several states; the majority of these teachers had taught ELLs but had not received any training to do so. Moreover, a national study of teacher education programs found that a minority of institutions of higher education require preparation for mainstream teachers on the topic of working with ELLs (Menken, Antunez, Dilworth, & Yasin, 2001). It should also be noted that, as of 2004, only 24 states had legal requirements that teachers in English as a Second Language (ESL) classrooms must be specially certified to work with ELLs (National Clearinghouse for English Language Acquisition FAQ, August 2006a).

The challenge of educating ELLs is an issue that will loom even larger in the future; U.S. Census projections suggest that the percentage of immigrants, at 11.9% of the total population in 2004, will increase to 13.5% by 2010 (Capps et al., 2005), and this shift will undoubtedly affect the proportion of ELLs in schools. The projected increase, combined with factors such as the state policies in Arizona that places limits on targeted language instruction for ELLs, make it likely that ever-greater proportions of teachers across the United States will be working with ELLs, and that these teachers will not be well prepared to do so. Although the Teachers of English to Speakers of Other Languages (TESOL) field has addressed instruction in public school settings for many years, content disciplines have only more recently begun to see the presence of ELLs as an important issue in teaching and teacher preparation. Given the gravity of the challenge, what effective approaches have been identified for working with ELLs in the content areas, specifically, history, math, English language arts, and science? What pedagogical issues and topics are a concern in individual disciplines and what themes recur across those fields?

Method

To answer these questions, I searched a range of databases, including ERIC, JSTOR, Wilson Select Plus, Wiley Interscience, and Academic Search Premier, for material on the topic of mainstream teachers and ELLs. I took 1990 as a cutoff point and used the following descriptors: English language learners, science, math, mathematics, history, social studies, English, content areas, and secondary teaching. When articles that fit the review parameters described below were identified, the descriptors used to identify those articles were entered into the databases and more articles were obtained. The cutoff date of 1990 remained constant throughout.

The majority of the material I discuss was published in peer-reviewed journals; however, the bibliographies provided in each article were also searched for additional relevant sources, which included books and research reports. The literature reviewed in this study is not exhaustive; some articles that fit the parameters outlined below

were omitted if they would appear repetitious when discussed in a general survey such as this one. For example, the large research project on instructional congruence described in the science section has generated an extensive array of articles and research reports; this article does not discuss all of them. Moreover, though the research databases were searched multiple times, articles appeared under many different descriptors, and it is possible that some sources were overlooked.

In initial passes through published material, I considered only articles that included an empirical investigation of some sort, even if that investigation was very limited in scope. However, relatively few research studies have been published in several disciplines, in particular English; therefore, I have added brief discussions of articles describing teaching approaches that are not tested through research. These articles provide a fuller picture of what is valued in individual content areas and across the disciplines; they can also give insight into what directions would be particularly valuable for research. For a similar reason, that is, to get the fullest picture of the disciplines, I have included studies of elementary through secondary school, provided that they focus on the teaching of specific content areas and not simply on instruction for ELLs in unspecified "mainstream" classes. In science, in particular, omitting studies at the elementary school level would cut off an important strand of research that can shed light on ongoing discussions about the best approaches for serving ELLs. I have, however, omitted sources that provide recommendations for teachers in general, as these do not necessarily reflect disciplinary concerns.

Although the majority of the work surveyed focuses on U.S. schools, I have included studies carried out in Australia and Canada; these countries have experienced challenges similar to those found in the United States in working with immigrant and refugee students. Again, my ultimate purpose is to provide the fullest picture of promising practices.

Within the disciplines, I have broken down the articles into subcategories focusing on academic literacy, teaching, and professional development issues. Academic literacy is a complex phenomenon, and is frequently described as incorporating linguistic, cognitive, and sociocultural concerns (Kucer, 2005). Although these concerns are not discrete, much of the research described here emphasizes one out of three. Moreover, by separating the review into these broad areas, trends common to the four disciplines become more evident.

In the most inclusive category, linguistic, researchers address several topics: vocabulary, grammar, the pragmatics of language use, and text structure or genre. At times, individual linguistic topics are reviewed, as in an article in the field of English that describes research on vocabulary teaching. Other articles address multiple topics: One overarching approach found in all the content areas is a description of school texts and literacy tasks based on systemic functional linguistics (SFL). In SFL, texts are analyzed across three dimensions: field (what is written about); tenor (the relationship between reader and writer); and mode (how a text is structured). Though SFL research focuses on linguistic choices, these choices interact with social context: Context affects what language is used, while, at the same time, language construes meaning in that context. Researchers and teachers using an SFL paradigm consider questions such as the characteristics of texts within a particular discipline, both those students read and those they write, and how the reading and writing of academic texts can be taught.

Articles that solely address cognitive topics, that is, mental processes that will assist students in becoming more effective readers, writers, or learners, are rare. Cognitive topics can be found in math (a study on problem-solving strategies and an article recommending strategy teaching) and in English (several studies on the use of reading strategies) and are also addressed in a number of articles that cover a broad array of pedagogical recommendations.

The studies examining sociocultural issues are much more common, but are found most frequently in science and in math. The sociocultural dimension of academic literacy is broad, concerning itself with the social context of learning, both at school and in the wider community, and with the ways in which that context affects students' academic success. Articles placed in the sociocultural domain generally focus on one of two subjects: (a) analysis of classroom events and how ELLs are positioned in a particular setting; or (b) the adaptation of instruction to particular cultural or first-language groups.

In the subsections on pedagogy, I have included research reports that cover topics such as inquiry learning in science or other approaches that do not isolate linguistic, cognitive, or sociocultural topics, as well as compilations of recommendations. Finally, there are several articles in the areas of history, science, and math that focus on teacher education or professional development. Again, I should note that I am not considering literature that addresses teacher education in general, only articles that focus on teacher education from a disciplinary perspective.

In this review of research, I will discuss the fields in the following order: history, math, English, and science. Within each discipline, I will consider linguistic, cognitive, and sociocultural issues, and then look at material on general instructional practices and teacher education.

Findings

History

Three strands of research and pedagogical information are represented in the discipline of history: reports on the linguistic challenges of subject area texts and of learning history, the social context of the mainstream classroom setting, and general pedagogical suggestions.

Linguistic Issues

Several articles address the linguistic challenges presented by history through the lens of SFL. In these studies, the authors describe how language is used to construe meaning in history textbooks, citing features such as high lexical density (the number of content words per clause) and extensive nominalization (Schleppegrell, 2004; Schleppegrell & Achugar, 2003; Schleppegrell, Achugar, & Orteiza, 2004). Through linguistic analysis, Schleppegrell and her colleagues demonstrate that reading and writing in history make unique demands on students in general, and that the language of history textbooks can be very difficult for ELLs in particular. The authors recommend that social studies teachers explicitly teach their students the grammatical features of history language to develop learner proficiency in reading and writing. In one example of what this recommendation could mean in practice, the authors explain how students can be taught to identify different types of verbs while reading textbook passages (Schleppegrell & Achugar, 2003;

Schleppegrell et al., 2004). They connect this sort of analysis to critical questions that teachers and students investigate in history classes, among them, whose opinions or views are presented in a given text, what those views are, and whether those views agree or disagree.

Three other authors make related arguments, proposing that some form of linguistic knowledge be explicitly taught. Nussbaum (2002) describes a classroom study in which sixth-grade students were given a graphic organizer to scaffold their writing of a specific genre—a historical argument. The graphic required the students to answer such questions as what their evidence was and how that evidence related to the position they were advocating. The scaffold had some positive effects on student writing: For example, the students provided more complete arguments at the end of the year than they had at the beginning. Nussbaum speculates, however, that more explicit instruction in the requirements of the genre might have increased the usefulness of the graphic. In another study focusing on writing instruction in history, Reppen (1994/1995) examined a fifth-grade social studies classroom in which students were taught multiple genres (narrative, description, persuasion, and exposition) through a combination of teacher modeling, explicit teaching about the language and structure of individual genres, and joint construction of texts. Reppen states that several types of assessment demonstrated that this approach produced positive change in terms of student content knowledge, writing proficiency, and attitudes toward social studies learning.

Finally, Tang (1992/1993) describes a seventh-grade social studies classroom in which the teacher also focused on text structure and content learning. This article makes use of a particular framework, that is, knowledge structures (KS). In the KS framework, all knowledge is viewed as being expressed in terms of one of six structures: classification, description, principles, sequence, evaluation, and choice. The teacher in this study analyzed sections of the textbook according to this system, identifying several different structures. She then developed graphic organizers to represent the structures she had identified, using a timeline for sequence, for example. The organizers assisted the teacher to plan her lessons, in that she used different graphics to introduce students to content and also to get them to engage with it. In addition, the graphics allowed the teacher to focus on the linguistic devices associated with particular structures, and, as a result, she explicitly taught this language to the students. Tang notes that, although no specific evaluation of the effectiveness of this approach was carried out with this particular class, other research has shown that this approach to integrating language and content can assist students in comprehending and producing academic discourse.

Another strand of language and history teaching is represented by Short (1994, 1995, 2002), who discusses an ongoing investigation of ELLs learning social studies in middle school. As is done by the systemic functional linguists, Short examines the language of textbooks in terms of structure and vocabulary. However, her analysis is more wide-ranging, and she also looks for evidence of cultural diversity, identifying very few examples of it (1994, 1995). In her 2002 article, Short researched interactions in sheltered social studies classes at the middle school level to see how four different teachers balanced content, language, and task instruction. She found that the teachers were much more likely to discuss content and task rather than language, where language teaching is defined as “instruction that teachers provide to help students acquire semantic and syntactic knowledge of English,

and pragmatic knowledge about how English is used” (2002, p. 19). She found this result problematic, taking the position that language teaching should be integrated into content-area instruction, although she is more general in her recommendations than the systemic functional linguists. She suggests that teaching should include “explicit instruction in the four language skills; the development of functional language use; the acquisition of vocabulary, grammar, and mechanics” (p. 22). Though she emphasizes the importance of language instruction and of connecting language and content objectives, she also states that teachers should develop students’ cognitive skills.

Two other articles (Bunch, Abram, Lotan & Valdés, 2001; Zwiers, 2006) make similar claims with regards to middle school students in social studies classes. Although they are discussing multidimensional approaches, as is Short, they frame their arguments to a great degree in terms of the development of academic language, and, therefore, I have placed their work in this section. Bunch and his coauthors describe a long-term school–university project that has been successful in enabling students to participate in classes with native English-speaking peers. Elements of the intervention include student analysis of model essays and coordination between content and teachers of English to Speakers of Other Languages (ESOL) to create curriculum that will develop student use of academic language. Zwiers’s approach is somewhat different, but he also emphasizes students’ functional use of academic language in history. His techniques include word walls that focus on different types of language and hand motions and chants to solidify student memory of specific vocabulary. Zwiers provides evidence that suggests his approach had positive effects: For example, in their final papers, students used academic language that they had encountered in class.

Though all the articles in this section address language issues and promote the use of explicit instruction of language as it is used in history writing, the studies based on SFL represent the most compelling perspective on content-area instruction, doubtless because they start from an extensively developed stance on the nature of language in general and on history of language in particular. Systemic-functional linguists view content as being construed and understood through language; language instruction is therefore not a separate or additional strand in the classroom, it is content instruction. However, though several studies have been published that attempt to draw connections between the sophisticated analysis of text and context found in SFL to classroom practices (see also the science section, below), the published research is at an early stage in terms of working with ELLs in North American public schools. Researchers such as Zwiers or Short, looking at classroom instruction as a whole, may provide more detailed and directly implementable classroom teaching suggestions. This is true of Short in particular, both in her work on social studies and in more general discussions of sheltered content instruction (see, for example, Short, 1991; Echevarria, Vogt, & Short, 2007).

Sociocultural Issues

An article by Duff (2001) straddles teaching and sociocultural issues. Through observation and student interviews, Duff investigated the experiences of ELLs in two mainstream 10th-grade classes in Canada. Several themes emerged from this research, the most prominent being that the information and skills needed for students

to be successful went beyond linguistic and history knowledge to include factors such as familiarity with popular culture, confidence, and the ability to participate in “quick-paced, highly intertextual interactions” (p. 120). Moreover, the ELLs in the study were generally very quiet in class discussions and expressed fear of being ridiculed by native English speakers, who saw them as a silent, undifferentiated mass, ignoring their different backgrounds and personalities. The author provides an array of pedagogical suggestions based on what she observed; these range from more explicit teaching of language in terms of text structure and vocabulary to more attention being paid to students’ social-psychological needs by teachers. Though Duff does not state this directly, this last point would also entail broadening the perspectives of ELLs’ English-speaking classmates.

Pedagogical Issues

A group of articles provides teaching suggestions for history (Brown, 2007; Egbert & Simich-Dudgeon, 2001; Field, Wilhelm, Nickell, Culligan, & Sparks, 2001; Olmedo, 1993; Pappamihiel, Lake, & Rice, 2005; Salinas, Fránquiz, & Guberman, 2006; Seda, Liguori, & Seda, 1999; Szpara & Ahmad, 2007; Urdanivia-English, 2001; Weisman & Hansen, 2007). Most of these articles describe the authors’ experiences as teachers or researchers, but they do not refer to research in which the effectiveness of the recommended techniques was measured through assessment or focused observation. In these articles, linguistic, cognitive, and sociocultural concerns are all addressed. Linguistic issues are primarily oriented toward vocabulary teaching and learning (Pappamihiel et al., 2005; Salinas et al., 2006; Weisman & Hansen, 2007). Cognitive issues also address vocabulary knowledge; teachers can, for example, assist students to utilize strategies such as recognizing cognates or word roots when reading (Field et al., 2001; Szpara & Ahmad, 2007). In addition, teaching techniques designed to foster active processing of content are recommended; these include the use of guiding questions and brainstorming (Brown, 2007; Seda et al., 1999). Suggestions relating to sociocultural issues are wide-ranging: For example, at the high school level, Szpara and Ahmad describe classrooms in which the teachers attempted to provide “social and cultural support” (2007, p. 189) for their students by using the students’ first language, among other means. Several authors recommend projects that connect to the students’ home languages and cultures (Olmedo, 1993; Urdanivia-English, 2001). Other suggestions, such as the use of photographs, children’s literature, or texts written at lower grade levels, graphic organizers, and group work, straddle the domains of literacy (Brown, 2007; Field et al., 2001; Salinas et al., 2006; Seda et al., 1999). Finally, Egbert and Simich-Dudgeon (2001) discuss a range of teaching techniques with an emphasis on technology (word processing or other software programs) and the use of storytelling and personal narrative to engage students with course content. It should be noted that the latter suggestion represents a very different perspective on language use from that taken by systemic functional linguists, who emphasize the reading and writing of academic texts.

Teacher Education and Professional Development

Schleppegrell et al. (2004) describe an ongoing professional development program in which history teachers are receiving training in how knowledge based on the paradigm of SFL can be used in classroom instruction. The authors state that

they have refined their approach through teacher feedback and classroom observation, but do not discuss formal measures of efficacy.

Math

Like history, math is a somewhat underresearched discipline, perhaps because of a misguided belief that math is less difficult for ELLs because it is based on a language of numbers. Veel (1999), working from an SFL perspective, contradicts this belief, noting that language is a critical issue in math teaching since most of the content is conveyed through oral language, students do not derive a significant portion of their knowledge from reading textbooks, and teachers do the majority of the talking in classrooms. Although Veel does not address the concerns of second-language learners, other articles have, though most utilize a less complex definition of language than that provided by SFL.

A large portion of published material in the field of math deals with teaching students of Latino/Latina descent. For this reason it is sometimes difficult to separate out linguistic, cognitive, sociocultural, and pedagogical strands. In the discussion below, articles are placed into these categories for the purposes of identifying critical issues, but several of the articles address multiple topics.

Linguistic Issues

A research review of the features of mathematics language (Schleppegrell, 2007) outlines a range of challenges that math can present in SFL terms. These features include the use of more than one semiotic system (symbolic notation, visual displays such as graphs, written and spoken language); technical vocabulary; and grammatical features including complex noun phrases. Schleppegrell suggests that a focus on language is critical for student learning in the classroom, that both students and teachers should use math language, and that instruction should assist students to move from everyday language to the more formal register of math.

An edited volume published by the National Council for Teachers of Mathematics (*Changing the faces of mathematics: Perspectives on Latinos*) also addresses many of the questions covered by Schleppegrell. The information in this volume is, for the most part, derived from the authors' experiences in teaching and observing in elementary math classrooms; the contributions include data such as excerpts from classroom transcripts, but they are not couched as formal research reports.

In one article focused solely on language issues, Ron (1999) observes that the language of math and the language of everyday life can overlap, but that math language is used to express concepts that are not necessary or important in everyday usage. Additionally, mathematics may require specialized meanings for words. She points out that one of the challenges for ELLs in learning mathematical language is that it can only be acquired in school and not through conversational interaction. For bilingual students, a number of additional problems could present themselves: a limited understanding of the everyday language that is used as a base for understanding of the language of math, imperfect transference of math knowledge from one language or another, and teachers whose knowledge of the mathematics register in the students' first language is limited. Ron concludes by stating that bilingual teachers need to fully understand the linguistic characteristics of classroom language and also must have mastery of techniques that will assist students in connecting everyday language with the language of math.

Several other authors in this volume echo these concerns. For example, in an article based on an ongoing project to improve math instruction in elementary school, Lo Cicero, Fuson, and Allexaht-Snyder (1999) demonstrate how word problems can be derived from students' personal narratives, thus enabling students to grasp "mathematized" language. In a second article, Hernandez (1999) emphasizes the importance of using familiar language to understand new concepts and gives examples of teachers who explicitly instruct students in the meanings of cognates. In a third study, this one of an effective bilingual fifth-grade teacher, Khisty and Viego (1999) describe several teaching practices that promote mathematical thinking, among them the teacher's consistent and clear use of math terminology combined with the teacher's requirement that students use math language in the same way. This behavior is in contrast to other contexts observed by Khisty (see below), in which teachers' use of math language was confusing or unhelpful.

Finally, Lager (2006) investigated the linguistic challenges of algebra problems. He assessed 221 middle school students, both native speakers and ELLs, comparing the correctness of their responses to other data, including terms they highlighted as being confusing. He found that some of the words that caused problems were not ones that are generally considered to be part of the mathematics register, for example, "extension" and "previous." He also noted that more conceptually abstract terms are more difficult, and suggests that a new semantic category, "levels of linguistic abstraction" be created and examined (p. 192). He concludes by stating that mathematics teachers must be aware that language issues are fundamental to effective teaching.

Cognitive Issues

While cognitive topics pervade discussions of math teaching, few articles address them exclusively. One that does (Chamot, Dale, O'Malley, & Spanos, 1992) examines cognition and math teaching in the context of the Cognitive Academic Language Learning Approach (CALLA), an instructional method designed to act as a bridge between sheltered and mainstream programs for upper elementary and secondary school ESL students. The math strategies taught in CALLA overall range from cognitive strategies such as using imagery to solve a problem to metacognitive ones such as self-monitoring. In this study, students were also taught a specific sequence of steps to use in solving math problems. Chamot and her colleagues compared students who were learning in classrooms in which CALLA was implemented to a high degree to students from low-implementation classrooms. Implementation of CALLA was measured in a variety of ways, including teachers' responses to questionnaires and classroom observation. The data consisted of an interview and think-aloud task in which each student was asked to solve a math problem. The results indicated that students from high-implementation classrooms were more likely to use the problem-solving steps in the correct sequence, to use metacognitive strategies, and to solve the problem correctly.

Another article advocates the use of a form of reciprocal teaching to assist students in solving math problems (van Garderen, 2004). In reciprocal teaching, students read in small groups using cognitive strategies to comprehend the text. The four strategies used in this study were: clarifying the meaning of words and phrases, questioning to identify the key elements of a problem, summarizing the

purpose of the problem, and coming up with a plan to solve it. The author describes how students can be taught to use this approach, but did not empirically test its usefulness through tests of student achievement.

Sociocultural Issues

Many studies have considered sociocultural issues in mathematics, in that they address the teaching of Latino/Latina learners, but, though they describe the challenges faced by this particular group of students, the authors' emphasis is on linguistic or cognitive issues. The studies described below, however, more directly address sociocultural concerns, in particular, the nature of teacher beliefs and instructional approaches in effective classrooms or programs serving Latino/Latina students. An extended study by Gutiérrez (2002) investigated a high school mathematics department in which the teachers have been successful at getting their students to take mathematics classes beyond what is required for high school graduation. Gathering data through observations and interviews of teachers and students, Gutiérrez describes the attitudes and classroom techniques that characterized three focal teachers in this department. She notes that the teachers possessed several characteristics that made them good at working with their primarily bilingual students. First, they were careful observers of the students and were able to identify their needs and backgrounds without relying on stereotypes. Second, the teachers didn't require their students to speak in English at all times, thus demonstrating that they valued their students' first language and culture. This was the case even when the teachers themselves didn't understand Spanish. Third, the teachers asked students to work in cooperative groups, in that way giving the learners opportunities for exploring ideas through discussion.

In a related study, the elementary–middle school serving a majority Mexican-American population was examined (Gutstein, Lipman, Hernandez, & de los Reyes, 1997). As did Gutiérrez, the researchers gathered extensive data, including field notes, interviews, and reflective journals, to arrive at a complex picture of instruction. They note that an important aspect of effective teaching is for teachers to build “connections with families to create classroom cultures that mirror students' own” (p. 733); teachers may also utilize the students' first language as a means of empowering them in the classroom, a finding similar to that of Gutiérrez. The authors stress, however, that teachers must have a critical perspective on culture, seeing both the positive aspects as well as ones that may not promote academic success, for example, attitudes about gender roles.

Daisey and José-Kampfner (2002) provide a different insight on this last point in their article examining an urban school in which all the students were recent immigrants from Puerto Rico or Mexico. In this school, math and language arts teachers developed a collaborative project combining math instruction, writing, and storytelling with the end goal of building “student self-esteem through expanding the range of available role models” (p. 579). Teachers told biographical stories about successful Latina mathematicians and engineers, using the subsequent discussion as a means of understanding students' prior knowledge. The storytelling activities affected students positively in visible ways. After a year, many more students displayed awareness of professional or technical careers for women, as measured by drawings they produced of Latinas at work.

Pedagogical Issues

Two studies by Khisty (1991, 1995) examined how teachers explained mathematics in classrooms with a significant proportion of Hispanic students. Because these studies touch on linguistic, cognitive, and sociocultural issues fairly equally, I have placed them in this section. In one study (1991), focusing on fifth-grade classrooms, Khisty found that little actual mathematical terminology was used by the teachers she observed, and that most of the lessons focused on procedures for solving problems. Moreover, there was no discussion that would enable the students to go beyond following directions to grasping the mathematical concepts involved. Khisty also notes that the material presented was “decontextualized,” meaning that little information such as visuals was provided on the blackboard or on an overhead; as a result, students had to follow information orally and deduce what was being discussed or referred to. In a second article that includes data from more classrooms (1995), she found that not all teachers clarified mathematical terminology in ways that were helpful for bilingual students and that not much Spanish was actually used in the classroom, although there were some students in all of the classrooms who did not speak English. She also notes that there were differing uses of talk in the classrooms; in one case, the teacher and student interaction was controlled and repetitive, but in another, the teacher and students used talk to develop the students’ understanding of math concepts. Khisty concludes by stating that research and teacher education should focus on how to engage students in higher-level mathematical thinking while also enabling teachers to structure instruction for the sociolinguistic needs of their particular students. To realize these goals, teachers must take advantage of students’ home languages and experiences rather than disregarding them. Moschkovich (1999) addresses related issues in an analysis of a lesson in a third-grade classroom. She describes several discourse moves on the teacher’s part that assisted students to participate in classroom discussion and to develop their mathematical understanding. These included asking students to listen to each other, prompting them to clarify their statements, building on their contributions, and restating their comments in more formal mathematical terms.

In a very different study focusing on instruction, Dixon (1995) looked at the role of a computer program in promoting students’ visualization ability in eighth-grade math classes that consisted of mixed native English-speaking and ESL populations. The program, *The Geometer’s Sketchpad*, enables students to construct hypotheses and receive immediate feedback on their correctness. Dixon compared intact classes in which students worked at length in small groups using the program (treatment condition) with classes in which students received more traditional, textbook-based instruction (control condition). She found that ELLs performed better in the treatment group than in the control group, and she suggests that one implication of her findings is that ELLs can acquire mathematical skills in a constructivist environment and can succeed to the same degree as their English-speaking counterparts. Here, Dixon’s results have a very different implication from Khisty’s; that is, that ELLs may not need instruction specifically designed for their sociolinguistic needs; Dixon concludes, however, by noting this is a question in need of further research.

Finally, a number of articles fall into the category of pedagogical recommendations (Basurto, 1999; Bresser, 2003; Buchanan & Helman, 1997; Garrison, 1997; H. Lee & Jung, 2004; Secada, 1998; Tevebaugh, 1998; Torres-Velasquez & Lobo,

2004/2005). Several themes run through these articles, most of which are addressed in the more research-oriented literature described above. First, teachers should pay attention to classroom interaction and should give students opportunities to talk their way through problems or make verbal explanations of their reasoning. When teachers require oral language use, students can discover alternate approaches to problem solving, and teachers can become more aware of what their students know or don't know. Second, several of the articles recommend that teachers use students' knowledge or interests to make connections to the math curriculum; alternatively, the authors claim that math studies are more meaningful if they are linked to other content areas (Basurto, 1999; Buchanan & Helman, 1997; Garrison, 1997; Tevebaugh, 1998; Torres-Velasquez & Lobo, 2004/2005). Three of the authors suggest that teachers use either cooperative learning or a variety of grouping practices in the classroom (Buchanan & Helman, 1997; Garrison, 1997; H. Lee & Jung, 2004); other proposed practices include the use of technology (Buchanan & Helman, 1997) or math journals (Garrison, 1997). Secada, as well as H. Lee and Jung, note that students should make use of the language they feel most comfortable in, and Secada adds that students should be encouraged to seek clarification throughout the lesson. He also points out that the mathematical assessments used should clearly distinguish between knowledge of mathematics and knowledge of language.

Teacher Education and Professional Development

Interestingly, the field of math has produced a number of articles that address the topic of preparing future teachers to work with culturally diverse students. See, for example, the edited volumes by Secada, Fennema, and Adajian (1995) or Rodriguez and Kitchen (2005), which look at both math and science. These volumes cover issues such as the importance of teacher belief in student achievement, the value of making connections between students' home cultures and course content, and the long-term nature of teacher development; however, the volumes do not, at least in their discussion of math teachers, focus specifically on the challenges of working with ELLs.

English

It is somewhat difficult to disentangle the content area of English from the disciplinary area of teaching ESOL. ESOL and English classes both emphasize the development of literacy skills, and English teaching is more likely than other content areas to address linguistic topics such as grammar or vocabulary knowledge. Moreover, ESOL instruction may act as the sheltered equivalent of English classes for ELLs. In this section, articles are included provided they either specifically refer to the teaching of English Language Arts or literature in English or state that they are describing students from classrooms that serve native English speakers as well as language minority learners, which would not be true of ESOL classes. More than is the case in other content areas, the majority of what has been published is teaching advice, most of which is comparable to that published in other areas. Notably, there is very little information about sociocultural issues.

Linguistic Issues

Systemic-functional linguists have analyzed the content area of English (Christie, 1998, 2002) and outlined teaching methodology (Derewianka, 1990), but this work

does not explicitly address the topic of ELLs. Several articles, however, have been published that utilize alternative linguistic approaches. A quasi-experimental study investigated the value of vocabulary teaching with fifth-grade monolingual and bilingual children in mainstream and bilingual classrooms (Carlo et al., 2004). Over the course of 15 weeks, the intervention students were taught 10 to 12 new words each week, encountering these words in the context of a thematic unit. Varied activities were used to promote student engagement with and understanding of the target words, including word association tasks, analysis of word roots, and cloze. The students were given a number of pretests and posttests that measured vocabulary knowledge as well as reading comprehension, and the authors found positive change over time in terms of both vocabulary and reading. They note that the specific techniques utilized had previously been found effective either with native English speakers or with ELLs, but this study demonstrates effectiveness with both groups and in context in which the learners are mixed in the classroom.

Dong (2004) straddles the border between linguistic topics and general pedagogy. She discusses how prevalent metaphorical language is and how difficult it can be for ELLs. She describes several techniques she observed teachers using to address this issue, including cross-cultural comparisons, collages, and etymological research; none of these techniques was measured in any way for their efficacy.

Cognitive Issues

Jiménez (1997), Jiménez and Gaméz (1996), and Wright (1997) discuss the characteristics of effective reading strategy instruction for ELLs in several different settings. In Jiménez (1997) and Jiménez and Gaméz (1996), the authors describe a short-term intervention carried out with Spanish-speaking middle school students in which they were taught how to deal with unknown vocabulary, to recognize Spanish cognates in English, to utilize background knowledge, and to ask questions. The data collected, which consisted of transcripts of all the interactions, indicated that students developed more awareness of their cognitive behavior as well as a more positive attitude toward reading, both of which are characteristics of skilled readers. Wright (1997) also looked at a short-term intervention, this one for high school students, in which the students were taught several strategies including inferencing, previewing, and guessing the meaning of unknown words. She found that the students showed improvement from pretests to posttests of reading comprehension and were more positive and confident in their outlook on reading.

Sociocultural Issues

An article by DeStigter, Aranda, and eddy (1997) falls squarely into the category of sociocultural concerns. The authors discuss a project in which a class of ELLs was paired with a class of academically at-risk, native English speakers. Over the course of 10 weeks, the students completed several tasks in which they shared information about themselves and their families, read and discussed short stories, and shared experiences. Although this article addresses a number of different pedagogical issues such as materials choice and writing instruction, the authors frame their description in terms of the struggles all the students faced in maintaining a positive social identity, and note that the activities in the project gave the non-native English speakers the opportunity to assert a uniquely Latino identity. They suggest that projects of this sort can be beneficial for all concerned—ELLs, native

English speakers, and teachers—in developing understanding of the students’ potential and of each other.

Pedagogical Issues

Several authors have written articles giving a variety of pedagogical recommendations in the content area of English. One study, though it addresses several aspects of teaching, is somewhat different from the others in this section in that it reports on a long-term intervention and makes use of a quasi-experimental research design (Saunders & Goldenberg, 1999). In this project, the authors are investigating an extensive program designed to teach literature in upper-elementary classrooms serving both ELLs and native English speakers. Two components of this program are literature logs and instructional conversations. Literature logs require students to make different sorts of written responses to a designated section of text, for example, analyzing it or connecting it to their own experiences, whereas instructional conversations are a type of interaction in which the teacher’s goal is not to transmit knowledge or a particular interpretation, but to assist learners in arriving at a complex level of understanding of a given text. The authors compare students assigned to one of four treatments: literature logs, instructional conversations, literature logs and instructional conversations, and control. Essays and posttests of reading comprehension showed some significant results for all the intervention groups, but the combination of instructional conversations and literature logs seemed to be most effective for ELLs. The authors suggest that ELLs who are transitioning into the mainstream “can participate successfully in grade-appropriate language arts curriculum if they are given the kind of support provided by instructional conversations and literature logs” (p. 296).

Perhaps because the authors in the rest of this section are addressing different ages and contexts of teaching, the pedagogical recommendations cover a great deal of ground. Two authors (Cook, 1996; Jacobs, 2001) write about their experiences teaching secondary school students, highlighting the value of dual-entry journals in which students comment on a particular section of text; they also stress the importance of arousing student interest before they begin a reading assignment. Other themes that run through the articles include the use of graphic organizers to assist student understanding of vocabulary and story organization (Cook, 1996; Cruz, 2004; Ernst-Slavit, Moore, & Maloney, 2002; Gersten & Jiménez, 1994); vocabulary instruction (Ernst-Slavit et al., 2002; Gersten, 1996; Gersten & Jiménez, 1994); finding ways to value students’ language, cultures, and opinions (Ernst-Slavit et al., 2002; Gersten & Jiménez, 1994; Jacobs, 2001); and requiring students to elaborate on their responses (Ernst-Slavit et al., 2002; Gersten, 1996; Gersten & Jiménez, 1994). In addition, different articles stress other topics such as the teaching of cognitive strategies or presenting material through multiple modalities, that is, both in oral and written forms. All of these suggestions, with perhaps the exception of dual-entry journals, have been made in other content areas as well.

Science

The topic of science teaching and ELLs has produced an immense array of research and teaching recommendations, enough information that one recent research survey was solely devoted to this topic (O. Lee, 2005). Because of the extent of material available in the discipline of science, I have omitted a discussion of

articles that recommend teaching approaches but do not describe empirical research (e.g., Keenan, 2004; Lincoln & Beller, 2004; Rice, Pappamihel, & Lake, 2004).

Linguistic Issues

Various articles utilizing an SFL perspective have been written about the language of science (Fang, 2000, 2004, 2006; Schleppegrell, 1998). However, although these analyses of science writing suggest that its complexity would present great difficulties for ELLs, only Schleppegrell specifically focuses on the behaviors of these students. In her 1998 article, she examines the texts produced by 128 seventh- and eighth-grade students, native and non-native English speakers from a variety of cultural and linguistic backgrounds, when asked to write a description by their science teacher. Her purpose in this analysis is to pinpoint which grammatical structures are particularly useful for the task of description (for example, verbs such as “be,” “have,” “looks like” that describe or identify) as well as the structures students found problematic (for example, using generic referents as themes for clauses). Schleppegrell concludes by stating that teachers need to be aware of the grammatical features of school genres such as description, and that they should explicitly teach these features to students.

In another example of how SFL can underpin the teaching of science, Macken-Horarik (2002) provides a case study of a secondary school teacher who used the science genre of explanation, “how or why things are done” (p. 21) as a means of developing her students’ understanding of human reproduction. The teacher passed through several stages of instruction in this genre: building up students’ knowledge of the field or topic, explaining the nature of genre, modeling the specific genre, joint construction of an explanation, and, finally, individual writing of a series of explanations. Macken-Horarik discusses the efficacy of this teaching in several ways, describing in detail how one ELL’s writing developed over the course of the semester. She also notes that the linguistic focus was effective in giving the teacher a means of “analyzing the learning context and deciding which teaching strategies are central at each stage to best realize the overall goals for learning” (p. 41). This study is a fully articulated example of how SFL can inform the explicit teaching of language, including text structure, vocabulary, and grammatical features, and how that explicitness can be used to develop student understanding of science. The power of this study derives in large part from the experience of the teacher, who was a participant in a long-term professional development process grounded in SFL. She was able, therefore, to integrate language and content teaching in sophisticated and meaningful ways.

Another, related, group of studies examines Canadian ELLs at the secondary level (Huang, 2000, 2004; Huang & Morgan, 2003). The project described in these articles was designed to investigate how students’ knowledge of content and language developed in a classroom setting. Although these articles refer in greater or lesser degree to SFL, the primary focus is on a different approach; that is, the knowledge structure analysis described above in the history section. In these studies, the students were taught about the structure of classification. Learners read a text on the forms of matter that utilized the classification structure and were presented with a graphic organizer that represented the ideas found in the text. They were given examples of several linguistic features used in classifications such as nominal groups that express subcategorization. Finally, the students wrote multiple drafts of a classification text, also on

the topic of matter. These drafts were then analyzed, and the authors suggest that more effective writing is a mark of content knowledge, where effectiveness is measured in terms of the use of linguistic features (for example, generic referents or appropriate lexis), as well as whether content terms have been defined and exemplified. This conclusion is one systemic-functional linguists would agree with; additionally, Huang and Morgan recommend explicit instruction in how texts are constructed, as do all authors who write about linguistic issues. In contrast to the Macken-Horarik study in particular, however, Huang and Morgan are reporting on a relatively brief intervention, and the research is not part of an extended, recursive project designed to make teachers aware of the linguistic features of academic genres and to understand how to effectively integrate language and content instruction.

Other articles in the linguistic area are primarily observational. Merino and Hammond (2001, 2002) studied the development of science writing in bilingual elementary classes. In one article, they examine the linguistic characteristics of different sections of lab reports written by students in a fifth-grade class. In a second article, they investigate different ways that teachers structured and presented writing assignments. For example, one teacher asked students to conduct an experiment, then discussed the results with the class, generating a consensus form of the lab notes, which the students then copied. Though aspects of this procedure are similar to those used by the teacher in the Macken-Horarik (2002) study (building up knowledge of the field, joint text construction), what Merino and Hammond are describing does not appear to be a focused series of practices in which teachers are basing their instruction on an in-depth understanding of how language construes meaning in science.

A final study, Kelly and Breton's (2001) analysis of two bilingual elementary school classrooms, falls between sociocultural and linguistic categories, in that the authors are investigating the discourse found in the classrooms in detail. I have placed this study in the linguistic category, however, as one of the authors' central findings is a description of the linguistic means the teachers used to give students opportunities to learn scientific investigation techniques. Examples of these means include explicit instruction on how texts should be written and bilingual code switching.

Sociocultural Issues

Considerable work has been done to investigate sociocultural questions in science, considering what the culture of science is, how it compares to the cultures ELLs bring to the classroom, and whether science instruction is taking students' backgrounds into account (see, for example, Barba, 1993; Krugly-Smolksa, 1995). In this section, I will focus on two projects that adopt very different positions on these questions.

The first project, led by Okhee Lee and Sandra H. Fradd, has investigated elementary science instruction carried out with students from differing cultural backgrounds. In the first step of this project, Lee, Fradd, and their collaborators attempted to determine how teacher-student discourse might differ among cultural groups, specifically monolingual English speakers, bilingual Spanish speakers, and bilingual Haitian Creole speakers (O. Lee & Fradd, 1996; Westby, Dezale, Fradd, & Lee, 1999). In O. Lee and Fradd (1996), the researchers placed a teacher of one language background with a pair of students from the same background and asked them to complete three tasks "representative of elementary science curriculum in

the United States” (p. 277). In analyzing transcripts of the interactions, the authors found somewhat different interactional and task engagement patterns among the three groups. The bilingual Spanish speakers, for example, utilized simultaneous turn-taking, whereas both the Haitian Creole speakers and the monolingual English speakers used linear turn-taking. The Creole speakers, however, also had pauses and wait times in their interactions that the English speakers did not. The authors suggest that the style exhibited by the English-speaking groups was most compatible with the discourses of science; the Haitian students, for example, seemed to overrely on the authority of the teacher, whereas the Spanish speakers’ use of multiple turn-taking did not reflect the “linear and sequential communication” on a single topic favored in science (p. 285).

According to Fradd and Lee, teaching students of differing cultural backgrounds in ways that are familiar to them, often called cultural congruence, should actually be instructional congruence, which “requires that teachers integrate academic disciplines with students’ linguistic and cultural experiences to promote academic achievement” (O. Lee, 2004, p. 69). In instructional congruence, students are prepared to succeed according to the standards of the science discipline, but for learning to take place, meaningful connections must be made to the knowledge, perspectives, and behavior students bring to the classroom. In most of Fradd and Lee’s writings, their explanation of instructional congruence is couched in general terms, and the examples they provide may not give a full picture of how their theory is manifested in classroom practice. For example, they state that instructional congruence is realized through Latino/Latina teachers coconstructing communication by talking at the same time as their students (Fradd & Lee, 1999), by using the Spanish language in the classroom, or by using examples of science content familiar to students such as boiling rice and beans (O. Lee, 2004). Fradd and Lee’s published reports suggest that achieving instructional congruence is a complicated task, as it is affected by several factors, including the cultural backgrounds of teachers and students, science teaching standards, and the understanding teachers have of instructional approaches like inquiry learning that are currently favored in the science domain. Fradd and Lee have trained teachers to implement instructional congruence in elementary school classrooms, and evaluations of this aspect of the project indicate that instructional congruence has a positive effect on student performance (Cuevas, Lee, Hart, & Deaktor, 2005; Fradd, Lee, Sutman, & Saxton, 2001; O. Lee, Deaktor, Hart, Cuevas, & Enders, 2005).

The work of Fradd and Lee has been criticized for viewing diverse cultural behavior, that of Haitians in particular, as incongruent with the discourse of science (Hudicourt-Barnes, 2003; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). This criticism is based on the work of another long-term project, *Chèche Konnen*, which means search for knowledge in Haitian Creole. The goal of *Chèche Konnen* is to provide bilingual students access to science learning through engagement in authentic science practices. Scientists, for example, “pose their own questions; plan and implement research to explore their questions; build and revise theories; collect, analyze, and interpret data; and draw conclusions and make decisions based on their research” (Rosebery, Warren, & Conant, 1992, p. 7). In one example of the work of *Chèche Konnen*, Hudicourt-Barnes (2003) describes the discourse of a middle school classroom in which the students make use of a Haitian style of conversation called *bay odyans*. In *bay odyans*, one

participant begins with a statement; another challenges, often in a theatrical manner designed to entertain the listeners; and the two argue. Hudicourt-Barnes suggests that when a particular style of *bay odyans* known as *diskisyon* is used in the classroom, the teacher does not act as the single source of information about science, and the students can use their interactional skills to expand their understanding in ways that resemble the behaviors of practicing scientists. This type of discourse utilizes a different orientation toward teaching and learning than that provided by instructional congruence.

A final study focusing on both linguistic and sociocultural concerns takes up a position somewhere between instructional congruence and that of *Chèche Konnen* (Moje, Collazo, Carrillo, & Marx, 2001). The authors of this study investigated the various discourses used in a seventh-grade bilingual Spanish classroom in which students were engaged in an inquiry-based science project on the topic of air quality. Over the course of a year, the authors gathered data that included field notes, classroom videotapes, interviews of teachers and students, and classroom artifacts such as students' writings. As with Fradd and Lee, the authors see a disjunction between the discourses students use in everyday life and those valued in science, but they go farther, suggesting that there were competing discourses within the classroom itself. For example, the curriculum provided by the school district focused on questions typical of a science classroom, rather than those of actual scientists or those questions identified as critical by the students themselves, an approach advocated by *Chèche Konnen*. The texts used in the curriculum unit also presented examples of competing discourses, as in a play designed to introduce students to central concepts in the unit. The play was written in the form of a narrative; neither plays nor narratives are text types privileged in science. In a subsequent writing assignment, students were asked to imagine what would happen if a factory opened in their neighborhood, leading the students to produce creative texts that were not connected to the discourses of science. The authors' concluding recommendations have elements of Fradd and Lee's work as well as *Chèche Konnen*. They suggest that teachers draw on students' "everyday Discourses and knowledges" (Fradd et. al, 2001, p. 489), explicitly teach about different discourses, and assist students in connecting their own literacies to the language and discourse of science. Teachers should create a "third space," in which a hybrid discourse is possible, one that combines both science and students' discourses; this final point is related to the arguments made by researchers at *Chèche Konnen*.

Researchers investigating sociocultural issues are concerned with providing minority students with opportunities to succeed in science learning, and they share the general goal of assisting students to "do" science, rather than to simply learn inert facts. The aims of Fradd and Lee differ from *Chèche Konnen* in that Fradd and Lee are putting their perspectives into practice on a large scale through teacher training (see below), and, as a result, classroom implementations of instructional congruence may be variable or formulaic. *Chèche Konnen*, in contrast, has a constructivist focus; its aim is to open up "the range of discourses allowed in science discussions" (Hudicourt-Barnes, 2003, p. 90), rather than to lead students into an already-defined formulation of scientific meaning-making. Warren et al. (2001) suggest that teachers and researchers should view students' perspectives as complementary to scientific discourse, rather than discontinuous; this conceptualization will allow teachers to view all students as capable possessors of "invaluable

intellectual resources” (p. 548)—a conclusion that Moje and her colleagues would, no doubt, agree with.

Pedagogical Issues

As noted above, because of the volume of material published on science, I have omitted articles that simply list recommendations for teaching. However, one article I have included consists primarily of the description of effective teaching practices, but it is based on a year-long observation of three high school biology teachers (Dong, 2002). In this study, the author identifies numerous techniques including comprehensible input, group work, hands-on activities, and multiple forms of input (for example, posters, overheads, pictures, diagrams). The author concludes by noting that, although individual practices differ, what the three teachers have in common are high standards, an approach to teaching ELLs that emphasizes elaboration of concepts rather than simplification, and attentiveness to student backgrounds and experience.

Two larger-scale studies have investigated a specific approach to science teaching, one widely advocated in the field, that is, an inquiry-based curriculum (Amaral, Garrison, & Klentschy, 2002; Hampton & Rodriguez, 2001). The concept of inquiry learning is based on the National Science Education Standards. According to these standards, students should learn scientific behaviors such as asking questions, gathering data, and considering evidence through hands-on activities (Hampton & Rodriguez, 2001). In both the studies outlined here, at least some of the instruction was provided to elementary school students in English as well as Spanish, and the authors found evidence of increasing academic success over time. In addition, teachers believed that inquiry-based instruction increased students’ language skills in both languages as well as their science knowledge (Hampton & Rodriguez, 2001). These studies are two of the few that address the use of students’ first language in content teaching (the others are in math); it is worth highlighting that in at least one study the use of the first language was perceived by the teachers as being beneficial.

Teacher Education and Professional Development

Two articles describe the development of evaluation instruments that are designed to measure teacher behavior. The first (Gibbons, 2003) was designed to promote constructivist teaching at the elementary level. The instrument registers whether teachers are using a range of techniques, such as the use of realia or questions adapted to the level of the students. Student behavior is also considered, but primarily in terms of what the teacher has asked the learners to do: work in groups, for example, or generate summaries of assigned texts. Gibbons states that use of the checklist and discussion of it with the teachers being observed increased the teachers’ use of desired instructional strategies.

The authors of another article developed a more complex evaluation instrument designed to analyze teacher understanding of how inquiry-based science teaching can be combined effectively with language development (Stoddart, Pinal, Latzke, & Canaday, 2002). The authors give examples of elementary school teacher reasoning on different levels of science–language integration, from seeing the two as discrete fields to understanding them as related dynamically. They suggest that effective professional development should break down the barriers between science

and language teaching, a point that would resonate, though in different ways, with all the researchers who write about science teaching for ELLs.

As noted earlier, Fradd and Lee's research on teaching in elementary science classrooms has also included a teacher education component. To assist teachers in incorporating instructional congruence in their classrooms, the researchers developed instructional units that include hands-on activities and discussion (Fradd et al., 2001). The authors incorporated teacher feedback in the design of these units, and teachers were taught to use them through a cycle of workshops, school-site meetings, and focused conversations. Several studies measured change in teacher belief and practices, two over the course of 1 year (Hart & Lee, 2003; Luykx, Cuevas, Lambert, & Lee, 2005), the other over the course of 3 years (Lee, 2004). The studies found positive changes in terms of teachers' effectiveness at promoting literacy skills and student understanding of science content, their greater acceptance of students' home languages and cultures, and their utilization of instructional congruence in the classroom. However, the authors also note that teachers require extensive support in changing their practices and that the change takes a great deal of time. This finding was supported by a smaller scale research study carried out with a 1st-year science teacher, in which the teacher was observed on a regular basis and given assistance in planning (Buck, Mast, Ehlers, & Franklin, 2005).

The material published in the science discipline is the richest of any content area, and, perhaps as a result, there is no consensus on how best to work with ELLs. The proposed solutions—instructional congruence, incorporation of student modes of discourse into classroom interaction, and explicit teaching of the discourses of science—do, however, have some elements that overlap, the most obvious of which is a requirement for teachers who are knowledgeable about a range of issues.¹ To realize all of what counts as best practices in the articles reviewed above, science teachers must not only be familiar with science content and how that content is constructed linguistically, but also familiar with the cultural practices and “ways of knowing” espoused by different groups of students. Moreover, teachers must see value in these differing practices and demonstrate their respect for them in meaningful ways in a classroom setting. Finally, teachers must be aware of instructional approaches that can effectively engage all students in “doing” science rather than simply memorizing facts; a stance that requires teachers to take on roles other than that of the expert and to initiate classroom activities that are student centered and exploratory (Warren & Rosebery, 1995).

Conclusion

The four content areas have devoted different amounts of attention to the question of teaching ELLs and done so in different ways. The discipline of science has investigated the topic the most fully, with researchers considering linguistic, sociocultural, pedagogical, and professional development issues in depth. Social studies, math, and English language arts have also addressed linguistic, sociocultural, and pedagogical matters in greater or lesser degrees. The least amount of attention has been paid to cognitive issues in all the disciplines.

Despite gaps and the need for further research, a number of overlapping concerns and findings are evident. The most frequently referenced claim is probably the centrality of language in content teaching. Though SFL provides the most fully

articulated perspective on this point, many other researchers have also addressed this issue, reaching generally similar conclusions. The language of academic texts, both the ones students read and the ones they produce, has distinctive features and meanings that may present a contrast to the language used in informal spoken interaction; academic language can also differ from one discipline to another. The academic uses of language as well as the meaning of individual words need to be explicitly taught for students to fulfill the genre or discourse requirements privileged in academic settings and to understand the material they encounter in, for example, history textbooks or mathematical word problems.

Language can play a critical role in enabling students to reach deeper levels of comprehension in several other ways. When teachers ask students to articulate their thinking processes, share ideas in groups, or think through new ideas verbally or in writing, students are extending their engagement with and understanding of new information. The language of oral interaction does not necessarily have to be English, a point mentioned in the fields of math and elementary science teaching. Finally, as a prerequisite for instruction, teachers must thoroughly understand how the language of their disciplines construes meaning and must use academic language in clear and consistent ways in the classroom.

A second theme, explicit instruction in cognitive behaviors such as learning or reading strategies, is less visible across the disciplines than are linguistic topics. However, articles in the domains of history, English, and math have suggested that the teaching of strategies can be effective in developing students' academic skills and engagement with learning. Moreover, a study examining the implementation of CALLA, which includes direct instruction of cognitive strategies, found improved student performance on state-mandated tests of reading and mathematics (Montes, 2002).

A third theme, professional development, receives some attention in the literature. Several researchers have suggested that teachers need extended time for professional development so that they can achieve a variety of objectives: (a) learn about the language of their discipline in depth, (b) become accustomed to integrating language and content instruction, (c) understand their attitudes toward cultural diversity and their assumptions about ELLs, and (d) successfully adapt the knowledge base they acquired in training to actual teaching. A further challenge in the area of professional development is that content-area teachers do not necessarily have either defined obligations or opportunities to learn about working with ELLs. In school settings, mechanisms may not exist for content-area teachers to receive training, and, even when training occurs, teachers may not implement the accommodations they have learned about, as one investigation found (Brown & Bentley, 2004). Power differentials and different disciplinary epistemologies also prevent meaningful in-service cooperation between ESOL and content-area teachers (Arkoudis, 2003; Creese, 2002), to the detriment of the students being served.

A final, overarching concern is the role of students' cultures, discourses, or literacies and how they affect academic success. A full discussion of this topic lies beyond the scope of this article, incorporating as it would a range of additional issues, including the use of students' first languages in school and an examination of the context of learning, in which learners may have limited access to the target language and are frequently victims of racism and prejudice (Katz, 1999). In the articles that address sociocultural issues in detail, however, there is a consensus

that who students are must be acknowledged and valued in effective teaching practice, although there is no exact agreement on how this can best be done. The proposed solutions range from the fairly minimal, use of materials or topics related to student background, to the maximal, the incorporation of student discourses into classroom practice.

Though researchers have different areas of interest and thus the luxury of choosing to consider one aspect of instruction or another, students are invariably affected by all the challenges addressed in the literature: the linguistic, cognitive, sociocultural aspects of literacy, as well as the professional education of their instructors. Much work remains to be done. For example, teaching recommendations abound in all the content areas and reports that are largely observational in nature have identified a number of issues that should be addressed in classroom instruction. However, there is a dearth of investigations of large-scale interventions that incorporate the teaching of linguistic and cognitive knowledge into content instruction. Smaller studies are also needed to consider the spectrum of settings and students present in American education. Though the issue of cultural background is important and often addressed, ELLs vary in other ways as well, such as their level of education or literacy in the first language, and these characteristics undoubtedly affect how instruction should be approached. Also, overall, more research has been done with students in the elementary and upper elementary grades than with high school learners; this is particularly true in the field of science. However, students at the middle and high school levels are less likely to receive targeted language instruction than are elementary school learners (Ruiz de Velasco & Fix, 2002). Moreover, the proportion of foreign-born immigrant children is greater in high school (7%) than elementary school (4%; Capps et al., 2005), and it is at least probable that foreign-born children require more assistance in language learning than do U.S.-born children.

There is also room for further research in the mechanisms of professional development; that is, how teachers can arrive at a full understanding of the relationships among language, content, teaching, and context, and how they can implement that knowledge in their disciplinary fields. Research could shed light on the specific means by which mainstream teachers in specific content areas are brought to understand and teach the essentially variable nature of language use—the differing ways in which languages are used in different contexts by different people for different purposes. Finally, research can investigate how to assist teachers, administrators, and native English-speaking students alike in viewing the presence of ELLs and their differing cultural practices as a resource, not simply as a problem to be dealt with or ignored.

Note

¹Constructivist views of science teaching do not appear to be easily combined with the sort of explicit teaching of language advocated by SFL researchers. However, *Chèche Konnen*, at least in its published reports, places more emphasis on the development of knowledge in classroom interaction and on assisting students to take on the roles fulfilled by practicing scientists than it does on writing and reading. It is at least conceivable that both approaches could occur in the same classroom.

References

- Amaral, O. M., Garrison, L., & Klentschy, M. (2002). Helping English learners increase achievement through inquiry-based science instruction. *Bilingual Research Journal*, 26(2), 213–239.
- Arkoudis, S. (2003). Teaching English as a second language in science classes: Incommensurate epistemology. *Language and Education*, 17(3), 161–173.
- Barba, R. H. (1993). A study of culturally syntonic variables in the bilingual/bicultural science classroom. *Journal of Research in Science Teaching*, 30, 1053–1071.
- Basurto, I. (1999). Conditions for reading comprehension which facilitated word problems for second language learners. *Reading Improvement*, 36(3), 143–148.
- Bresser, R. (2003). Helping English-language learners develop computational fluency. *Teaching Children Mathematics*, 9(6), 294–299.
- Brown, C. L. (2007). Strategies for making social studies texts more comprehensible for English-language learners. *The Social Studies*, 98(6), 185–188.
- Brown, C. L., & Bentley, M. (2004). ELLs: Children left behind in science class. *Academic Exchange Quarterly*, 8(3), 152–158.
- Buchanan, K., & Helman, M. (1997). *Reforming mathematics instruction for ESL literacy students*. Washington, DC: ERIC Digest.
- Buck, G., Mast, C., Ehlers, N., & Franklin, E. (2005). Preparing teachers to create a mainstream science classroom conducive to the needs of English-language learners: A feminist action research project. *Journal of Research in Science Teaching*, 42(9), 1013–1031.
- Bunch, G. C., Abram, P. L., Lotan, R. A., & Valdés, G. (2001). Beyond sheltered instruction: Rethinking conditions for academic language development. *TESOL Journal*, 10(2/3), 28–33.
- Byrnes, D. A., Kiger, G., & Manning, M. L. (1998). Classroom teachers and language-minority students. *Educational Research Quarterly*, 22(1), 26–31.
- Callahan, R. M. (2005). Tracking and high school English learners: Limiting opportunity to learn. *American Educational Research Journal*, 42(2), 305–328.
- Capps, R., Fix, M., Murray, J., Ost, J., Passel, J. S., & Herwanto, S. (2005). *The new demography of America's schools*. Washington, DC: The Urban Institute.
- Carlo, M. S., August, D., McLaughlin, B., Snow, C. E., Dressler, C., Lippman, D., et al. (2004). Closing the gap: Addressing the vocabulary needs of English-language learners in bilingual and mainstream classrooms. *Reading Research Quarterly*, 39(2), 188–215.
- Chamot, A., Dale, M., O'Malley, M., & Spanos, G. (1992). Learning and problem solving strategies of ESL students. *Bilingual Research Journal*, 16(3&4), 1–34.
- Christie, F. (1998). Learning the literacies of primary and secondary schooling. In F. Christie & R. Mission (Eds.), *Literacy and schooling*. (pp. 47–73). London and New York: Routledge.
- Christie, F. (2002). The development of abstraction in adolescence in subject English. In M. J. Schleppegrell & M. C. Columbi (Eds.), *Developing advanced literacy in first and second languages* (pp. 45–66). Mahwah, NJ: Lawrence Erlbaum.
- Cook, L. (1996). What is a “regular” English classroom? Language and cultural diversity in today's schools. *English Journal*, 85(8), 49–51.
- Creese, A. (2002). The discursive construction of power in teacher partnerships: Language and subject specialists in mainstream schools. *TESOL Quarterly*, 36(2), 597–616.
- Cruz, M. (2004). Can English language learners acquire academic English? *English Journal*, 93(4), 14–17.

- Cuevas, P., Lee, O., Hart, J., & Deaktor, R. (2005). Improving science inquiry with elementary students of diverse backgrounds. *Journal of Research in Science Teaching*, 42(3), 337–357.
- Daisey, P., & José-Kampfner, C. (2002). The power of story to expand possible selves for Latina middle school students. *Journal of Adolescent and Adult Literacy*, 45(7), 578–587.
- Derewianka, B. (1990). *Exploring how texts work*. Australia: Primary English Teachers Association
- DeStigter, T., Aranda, E., & eddy, L. (1997). The *Tesoros* literacy project: Treasuring students' lives. *English Journal*, 86(6), 89–92.
- Dixon, J. K. (1995). Limited English proficiency and spatial visualization in middle school students' construction of the concepts of reflection and rotation. *Bilingual Research Journal*, 19(2), 221–247.
- Dong, Y. R. (2002). Integrating language and content: How three biology teachers work with non-native English-speaking students. *International Journal of Bilingual Education and Bilingualism*, 51(1), 40–57.
- Dong, Y. R. (2004). Don't keep them in the dark! Teaching metaphors to English language learners. *English Journal*, 93(4), 29–35.
- Duff, P. A. (2001). Language, literacy, content, and (pop) culture: Challenges for ESL students in mainstream courses. *The Canadian Modern Language Review*, 58(1), 103–132.
- Echevarria, J., Vogt, M., & Short, D. (2007). *Making content comprehensible for English learners: The SIOP model*. Boston: Allyn & Bacon.
- Egbert, J., & Simich-Dudgeon, C. (2001). Providing support for non-native learners of English in the social studies classroom. *The Social Studies*, 92(1), 22–25.
- Ernst-Slavit, G., Moore, M., & Maloney, C. (2002). Changing lives: Teaching English and literature to ESL students. *Journal of Adolescent and Adult Literacy*, 46(2), 118–128.
- Fang, Z. (2000). The grammatical construction of scientific literacy. In T. Shanahan & F. V. Rodriguez-Brown (Eds.), *National Reading Conference yearbook 49* (pp. 367–380). Chicago: National Reading Conference.
- Fang, Z. (2004). Scientific literacy: A systemic functional linguistics perspective. *Science Education*, 89, 335–347.
- Fang, Z. (2006). The language demands of science reading in middle school. *International Journal of Science Education*, 28(5), 491–520.
- Field, S. L., Wilhelm, R., Nickell, P., Culligan, J., & Sparks, J. (2001). Teaching middle school social studies: Who is at risk? *Social Education*, 65(4), 225–233.
- Fix, M., & Passel, J. S. (2003). *U.S. immigration—Trends & implications for schools*. Washington, DC: The Urban Institute.
- Fradd, S. H., & Lee, O. (1999). Teachers' roles in promoting science inquiry with students from diverse language backgrounds. *Educational Researcher*, 28(6), 14–20.
- Fradd, S. H., Lee, O., Sutman, F. X., & Saxton, M. K. (2001). Promoting science literacy with English language learners through instructional materials development: A case study. *Bilingual Research Journal*, 25(4), 479–501.
- Garrison, L. (1997). Making the NCTM's standards work for emergent English speakers. *Teaching Children Mathematics*, 4, 132–138.
- Gersten, R. (1996). Literacy instruction for language-minority students: The transition years. *The Elementary School Journal*, 96(3), 227–244.
- Gersten, R., & Jiménez, R. T. (1994). A delicate balance: Enhancing literature instruction for students of English as a second language. *The Reading Teacher*, 47(6), 438–449.

- Gibbons, B. (2003). Supporting elementary science education for English learners: A constructivist evaluation instrument. *Journal of Educational Research*, 96(6), 371–380.
- Gutiérrez, R. (2002). Beyond essentialism: The complexity of language in teaching mathematics to Latina/o students. *American Educational Research Journal*, 39(4), 1047–1088.
- Gutstein, E., Lipman, P., Hernandez, P., & de los Reyes, R. (1997). Culturally relevant mathematics teaching in a Mexican-American context. *Journal for Research in Mathematics Education*, 28(6), 709–737.
- Hampton, E., & Rodriguez, R. (2001). Inquiry science in bilingual classrooms. *Bilingual Research Journal*, 25(4), 417–434.
- Hart, J. L., & Lee, O. (2003). Teacher professional development to improve the science and literacy achievement of English Language Learners. *Bilingual Research Journal*, 27(3), 475–501.
- Hernandez, N. G. (1999). The mathematics-bilingual-education connection. Two lessons. In L. Ortiz-Franco, N. G. Hernandez, & Y. De la Cruz (Eds.), *Changing the faces of mathematics: Perspectives on Latinos* (pp. 49–57). Reston, VA: National Council of Teachers of Mathematics
- Huang, J. (2000). Integration of academic content learning and academic literacy skills development of L2 students: A case study of an ESL science class. In T. Shanahan & F. V. Rodriguez-Brown (Eds.), *National Reading Conference yearbook 49* (pp. 392–404). Chicago: National Reading Conference.
- Huang, J. (2004). Socialising ESL students into the discourse of school science through academic writing. *Language and Education*, 18(2), 97–119.
- Huang, J., & Morgan, G. (2003). A functional approach to evaluating content knowledge and language development in ESL students' science classification texts. *International Journal of Applied Linguistics*, 13(2), 234–262.
- Hudicourt-Barnes, J. (2003). The use of argumentation in Haitian Creole science classrooms. *Harvard Educational Review*, 73(1), 73–93.
- Jacobs, C. L. (2001). "Those kids can't read this book—It's too thick." *English Journal*, 90(6), 33–37.
- Jiménez, R. T. (1997). The strategic reading abilities and potential of five low-literacy Latina/o readers in middle school. *Reading Research Quarterly*, 31 (3), 224–243.
- Jiménez, R. T., & Gaméz, A. (1996). Literature-based cognitive strategy instruction for middle school Latina/o students. *Journal of Adolescent and Adult Literacy*, 40 (2), 84–91.
- Katz, S. R. (1999). Teaching in tensions; Latino immigrant youth, their teachers and the structures of schooling. *Teachers College Record*, 100, 809–840.
- Keenan, S. (2004). Reaching English language learners. *Science and Children*, 42(2), 49–51.
- Kelly, G., & Breton, T. (2001). Framing science as disciplinary inquiry in bilingual classrooms. *Electronic Journal of Literacy through Science*, 1(1). Retrieved February 8, 2006, from <http://www.sjsu.edu/elementary/ejls/archives/bilingualism/kelly.pdf>
- Khisty, L. (1991). A naturalistic look at language factors in mathematics teaching in bilingual classrooms. Retrieved October 31, 2006, from <http://www.ncela.gwu.edu/pubs/symposia/third/khisty.htm>
- Khisty, L. (1995). Making inequality: Issues of language and meanings in mathematics teaching with Hispanic students. In W. Secada, E. Fennema, & L. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 279–297). New York: Cambridge University Press.

- Khisty, L., & Viego, G. (1999). Challenging conventional wisdom. A case study. In L. Ortiz-Franco, N. G. Hernandez, & Y. De la Cruz (Eds.), *Changing the faces of mathematics: Perspectives on Latinos* (pp. 71–80). Reston, VA: National Council of Teachers of Mathematics.
- Krugly-Smolka, E. (1995). Cultural influences in science education. *International Journal of Science Education*, 17(1), 45–58.
- Kucer, S. B. (2005). *Dimensions of literacy* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
- Lager, C. A. (2006). Types of mathematics–language reading interactions that unnecessarily hinder algebra learning and assessment. *Reading Psychology*, 27, 165–204.
- Lee, H., & Jung, W. S. (2004). Limited-English-Proficient (LEP) students and mathematical understanding. *Mathematics Teaching in the Middle School*, 9(5), 269–272.
- Lee, O. (2004). Teacher change in beliefs and practices in science and literacy instruction with English language learners. *Journal of Research in Science Teaching*, 41(1), 65–93.
- Lee, O. (2005). Science education with English language learners: Synthesis and research agenda. *Review of Educational Research*, 75(4), 491–530.
- Lee, O., Deaktor, R. A., Hart, J. E., Cuevas, P., & Enders, C. (2005). An instructional intervention's impact on the science and literacy achievement of culturally and linguistically diverse elementary students. *Journal of Research in Science Teaching*, 42(8), 857–887.
- Lee, O., & Fradd, S. H. (1996). Interactional patterns of linguistically diverse students and teachers: Insights for promoting science learning. *Linguistics and Education*, 8, 269–297.
- Lincoln, F., & Beller, C. (2004). English language learners in the science classroom. *Science Scope*, 28(1), 28–31.
- Lo Cicero, A. M., Fuson, K. C., & Allexaht-Snyder, M. (1999). Mathematizing children's stories, helping children solve word problems, and supporting parental involvement. In L. Ortiz-Franco, N. G. Hernandez, & Y. De la Cruz (Eds.), *Changing the faces of mathematics: Perspectives on Latinos* (pp. 59–70). Reston, VA: National Council of Teachers of Mathematics.
- Luykx, A., Cuevas, P. M., Lambert, J., & Lee, O. (2005). Unpacking teachers' "resistance" to integrating students' language and culture into elementary science instruction. In A. Rodriguez & R. S. Kitchen (Eds.), *Preparing prospective mathematics and science teachers to teach for diversity: Promising strategies for transformative action* (pp. 119–141). Mahwah, NJ: Lawrence Erlbaum.
- Macken-Horarik, M. (2002). "Something to shoot for": A systemic functional approach to teaching genre in secondary school science. In A. Johns (Ed.), *Genre in the classroom* (pp. 17–42). Mahwah, NJ: Lawrence Erlbaum.
- Menken, K., Antunez, B., Dilworth, M. E., & Yasin, S. (2001). *An overview of the preparation and certification of teachers working with Limited English Proficient (LEP) students*. Washington, DC: National Clearinghouse for Bilingual Education.
- Merino, B. J., & Hammond, L. (2001). How do teachers facilitate writing for bilingual learners in "sheltered constructivist" science? *Electronic Journal of Literacy Through Science*, 1(1). Retrieved January 31, 2006, from <http://www.sjsu.edu/elementaryed/ejlt/archives/bilingualism/merino.pdf>
- Merino, B. J., & Hammond, L. (2002). Writing to learn: Science in the upper-elementary bilingual classroom. In M. J. Schleppegrell & M. C. Columbi (Eds.), *Developing advanced literacy in first and second languages* (pp. 227–244). Mahwah, NJ: Lawrence Erlbaum.

- Moje, E. B., Collazo, T., Carrillo, R., & Marx, R. W. (2001). "Maestro, what is 'quality'?" Language, literacy, and discourse in project-based science. *Journal of Research in Science Teaching*, 38(4), 469–498.
- Montes, F. (2002). Enhancing content areas through a Cognitive Academic Language Learning based collaborative in South Texas. *Bilingual Research Journal*, 26(3), 697–716.
- Moschkovich, J. (1999). Supporting the participation of English language learners in mathematical discussions. *For the Learning of Mathematics*, 19(1), 11–19.
- National Center for Education Statistics (2002). *Schools and staffing survey: Overview of the data for public, private, public charter, and Bureau of Indian Affairs elementary and secondary schools*. Retrieved February 27, 2006, from http://nces.ed.gov/pubs2002/2002313_1.pdf
- National Center for Education Statistics (2005). *NAEP assessments*. Retrieved March 6, 2006, from <http://nces.ed.gov/nationsreportcard/>
- National Center for Education Statistics (2007). *Dropout rates in the United States: 2005*. Retrieved March 27, 2008, from <http://nces.ed.gov/pubs2007/dropout05/>
- National Clearinghouse for English Language Acquisition FAQ (2006a, August). *Which states offer certification or endorsement in Bilingual Education or ESL?* Retrieved February 21, 2007, from <http://www.ncela.gwu.edu/expert/faq/09certif.html>
- National Clearinghouse for English Language Acquisition FAQ (2006b, November). How many school-aged English language learners (ELLs) are there in the U.S.? Retrieved February 8, 2007, from <http://www.ncela.gwu.edu/expert/faq/011eps.html>
- Nussbaum, E. M. (2002). Scaffolding argumentation in the social studies classroom. *The Social Studies*, 93(2), 79–83.
- Olmedo, I. M. (1993). Junior historians: Doing oral history with ESL and bilingual students. *TESOL Journal*, 2(4), 7–10.
- Ortiz-Franco, L., Hernandez, N. G., & De la Cruz, Y. (Eds.). (1999). *Changing the faces of mathematics: Perspectives on Latinos*. Reston, VA: National Council of Teachers of Mathematics.
- Pappamihel, N. E., Lake, V. E., & Rice, D. C. (2005). Adapting a social studies lesson to include English language learners. *Social Studies and the Young Learner*, 17(3), 4–7.
- Pew Hispanic Center (2004). *Latino teens staying in high school: A challenge for all generations*. Washington, DC: Author.
- Reppen, R. (1994/1995). A genre-based approach to content writing instruction. *TESOL Journal*, 4(2), 32–35.
- Rice, D. C., Pappamihel, N. E., & Lake, V. E. (2004). Lesson adaptations and accommodations: Working with native speakers and English language learners in the same science classroom. *Childhood Education*, 80(3), 121–128.
- Rodriguez, A. J., & Kitchen, R. S. (Eds.). (2005). *Preparing mathematics and science teachers for diverse classrooms*. Mahwah, NJ: Lawrence Erlbaum.
- Ron, P. (1999). Spanish–English language issues in the mathematics classroom. In L. Ortiz-Franco, N. G. Hernandez, & Y. De la Cruz (Eds.), *Changing the faces of mathematics: Perspectives on Latinos* (pp. 23–34). Reston, VA: National Council of Teachers of Mathematics.
- Rosebery, A. S., Warren, B., & Conant, F. R. (1992). *Appropriating scientific discourse: Findings from language minority classrooms*. Santa Cruz, CA: National Center for Research on Cultural Diversity and Second Language Learning.
- Ruiz de Velasco, J., & Fix, M. (2002). Limited English proficient students and high-stakes accountability systems. In D. M. Piche, W. I. Taylor, & R. A. Reed (Eds.), *Rights at*

- risk: *Equality in an age of terrorism* (pp. 245–261). Washington, DC: Citizens' Commission on Civil Rights.
- Ruiz-de-Velasco, J., Fix, M., & Clewell, B. C. (2000). *Overlooked and underserved: Immigrant students in U.S. secondary schools*. Washington, DC: The Urban Institute.
- Salinas, C., Fránquiz, M., & Guberman, S. (2006). Introducing historical thinking to second language learners: Exploring what students know and what they want to know. *The Social Studies*, 97(5), 203–207.
- Saunders, W. M., & Goldenberg, C. (1999). Effects of instructional conversations and literature logs on limited- and fluent-English-proficient students' story comprehension and thematic understanding. *The Elementary School Journal*, 99(4), 277–301.
- Schleppegrell, M. J. (1998). Grammar as resource: Writing a description. *Research in the Teaching of English*, 32(3), 182–211.
- Schleppegrell, M. J. (2004). *The language of schooling*. Mahwah, NJ: Lawrence Erlbaum.
- Schleppegrell, M. J. (2007). The linguistic challenges of mathematics learning and teaching: A research review. *Reading & Writing Quarterly*, 23, 139–159.
- Schleppegrell, M. J., & Achugar, M. (2003). Learning language and learning history: A functional linguistics approach. *TESOL Journal*, 12(2), 21–27.
- Schleppegrell, M. J., Achugar, M., & Orteiza, T. (2004). The grammar of history: Enhancing content-based instruction through a functional focus on language. *TESOL Quarterly*, 38(1), 67–93.
- Secada, W. G. (1998). School mathematics for language enriched pupils. In S. H. Fradd & O. Lee (Eds.), *Creating Florida's multilingual global work force: Educational policies and practices for students learning English as a new language*. Tallahassee, FL: Florida Department of Education. Retrieved September 7, 2006, from <http://www.ncela.gwu.edu/pubs/florida/workforce98/secada/mathematics.htm>
- Secada, W. G., Fennema, E., & Adajian, L. B. (Eds.). (1995). *New directions for equity in mathematics education*. Cambridge, UK: Cambridge University Press.
- Seda, M. M., Liguori, O. Z., & Seda, C. M. (1999). Bridging literacy and social studies: Engaging prior knowledge through children's books. *TESOL Journal*, 8(3), 34–40.
- Sharkey, J., & Layzer, C. (2000). Whose definition of success? Identifying factors that affect English language learners' access to academic success and resources. *TESOL Quarterly*, 34(2), 352–368.
- Short, D. (1991). *How to integrate language and content instruction: A training manual* (2nd ed.). Washington, DC: CAL.
- Short, D. (1994). Expanding middle school horizons: Integrating language, culture, and social studies. *TESOL Quarterly*, 28(3), 581–608.
- Short, D. (1995). *The academic language of social studies: A bridge to an all-English classroom*. Paper presented at the Annual Meeting of the National Association for Bilingual Education, Phoenix, AZ.
- Short, D. (2002). Newcomer programs: An educational alternative for secondary immigrant students. *Education and Urban Society*, 34(2), 173–199.
- Stoddart, T., Pinal, A., Latzke, M., & Canaday, D. (2002). Integrating inquiry science and language development for English language learners. *Journal of Research in Science Teaching*, 39(8), 664–687.
- Szpara, M. Y., & Ahmad, I. (2007). Supporting English-language learners in social studies class. *The Social Studies*, 98(6), 189–195.
- Tang, G. (1992/1993). Teaching content knowledge and ESOL in multicultural classrooms. *TESOL Journal*, 2(2), 8–12.

- Tevebaugh, T. N. (1998). Mathematics is not a universal language. *Teaching Children Mathematics*, 5(4), 214–216.
- Thomas, W. P., & Collier, V. P. (2001). *A national study of school effectiveness for language minority students' long-term academic achievement*. Santa Cruz, CA: Center for Research on Education, Diversity & Excellence.
- Torres-Velasquez, D., & Lobo, C. (2004/2005). Culturally responsive mathematics instruction. *Teaching Children Mathematics*, 11(5), 249–255.
- Urdanivia-English, C. (2001). Whose history? Social studies in an elementary English class for speakers of other languages. *The Social Studies*, 92(5), 193–197.
- van Garderen, D. (2004). Reciprocal teaching as a comprehension strategy for understanding mathematical word problems. *Reading and Writing Quarterly*, 20(2), 225–229.
- Veel, R. (1999). Language, knowledge and authority in school mathematics. In F. Christie (Ed.), *Pedagogy and the shaping of consciousness: Linguistic and social process* (pp. 185–216). London: Continuum.
- Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A., & Hudicourt-Barnes, J. (2001). Rethinking diversity in learning science: The logic of everyday languages. *Journal of Research in Science Teaching*, 38, 529–552.
- Warren, B., & Rosebery, A. (1995). Equity in the future tense: Redefining relationships among teachers, students, and science in linguistic minority classrooms. In W. Secada, E. Fennema, & L. Adajian (Eds.), *New directions for equity in mathematics education* (pp. 298–328). New York: Cambridge University Press.
- Weisman, E. M., & Hansen, L. E. (2007). Strategies for teaching social studies to English-language learners at the elementary level. *The Social Studies*, 98(6), 180–184.
- Westby, C., Dezale, J., Fradd, S. H., & Lee, O. (1999). Learning to do science: Influences of language and culture. *Communication Disorders Quarterly*, 21(1), 50–65.
- Wright, L. (1997). Enhancing ESL reading through reader strategy training. *Prospect*, 12(3), 15–28.
- Zwiers, J. (2006). Integrating academic language, thinking, and content: Learning scaffolds for non-native speakers in the middle grades. *Journal of English for Academic Purposes*, 5(4), 317–333.

Author

JOY JANZEN teaches at Stony Brook University, Linguistics Department, Stony Brook, New York 11794-4376; e-mail: Joy.Janzen@stonybrook.edu. Her research interests include second-language reading, teaching ELLs in public school settings, teacher education, and literacy acquisition.