Supporting Emergent Multilingual Learners in Science

Grades 7–12

Molly Weinburgh
Cecilia Silva
Kathy Horak Smith

NSTApress
National Science Teachers Association

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Contents

Dedication

We dedicate this book to all students and teachers who have influenced our thinking. Specifically, for their support, we thank the following:

- Fort Worth Independent School District
- Andrews Institute of Mathematics & Science Education
- Texas Christian University
- Tarleton State University
- City of Granbury
- Our families

Preface

Instruction using the 5E learning cycle (Bybee at al. 2006) and the *Next Generation Science Standards* (NGSS Lead States 2013) is not enough if emergent multilingual learners (EMLs) are to engage in rich science content and language.[1] Therefore, we offer the 5R Instructional Model (Weinburgh and Silva 2011a, 2011b, 2013; Weinburgh, Silva, and Smith 2014) as a tool for purposeful scaffolding of language in the science classroom. The 5E learning cycle (engage, explore, explain, extend, evaluate) has been a standard in science education for decades. Starting a lesson by eliciting prior knowledge focuses the learner's attention on the task and provides a time for using language. Exploring nature phenomena and collecting data to develop an explanation helps develop not only science content and practices, but also language. This cycle is consistent with the 5R Instructional Model. Each *R* (replace, reveal, repeat, reposition, reload) may be manifested in any of the phases of the learning cycle. Our goal is to produce a resource that middle and secondary teachers can use to learn more about the integration of inquiry-based science and multimodal language instruction for EMLs. As a team engaged in both teaching and researching, we recognize our professional growth as we work to integrate our disciplines: science (Molly), mathematics (Kathy), and language (Cecilia). We invite you to read about our work and join us on this academic journey.

The first four chapters of this book serve as an overview to frame the 5R Instructional Model. Each chapter begins with a scenario describing an instructional event in a science classroom with EMLs. In Chapter 1 (p. 1), we attempt to capture the wide range of EMLs who come together in classrooms where science and language learning are integrated. In Chapter 2 (p. 9), we explore the social language of science and examine meaning-making through the lens of the multimodal language of science: natural language, mathematical expressions, visual representations, and manual-technical operations. In Chapter 3 (p. 21), we focus on science as a context for language learning. We explore inquiry practices of science and conclude with an example of a science lesson. Chapter 4 (p. 35) outlines the 5R Instructional Model and briefly describes the five *R*s.

Chapters 5–9 focus on the five *R*s, and each begins with a scenario that highlights the relevant *R*. A rationale presents how the *R* is situated within the academic context. In Chapters 5–8 (pp. 45, 57, 67, and 75), we discuss and provide examples of the four modes of hybrid language in relation to each *R*. In Chapter 9 (p. 89), we focus on vocabulary as it relates to word meaning in the process of reloading.

Finally, Chapter 10 (p. 97) brings the work full circle. We provide the voices of teachers who have used the 5R Instructional Model as a tool in developing their own science lessons. Thinking of this model as an overlay when using the learning cycle, these teachers express their ability to provide better instruction for EMLs.

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1 We have chosen to use *emergent multilingual students* to acknowledge the bilingual/multilingual home language practices of the middle and secondary students learning science as well as English in U.S. schools today.

About the Authors

Molly Weinburgh, Andrews Chair of Mathematic and Science Education, is the director of the Andrews Institute of Mathematics and Science Education at Texas Christian University. Her scholarship focuses on academic language acquisition and conceptual understanding in science by emerging multilingual students. She served as co-editor of *Science Teacher Preparation in Content-Based Second Language Acquisition* (Oliveira and Weinburgh 2017) and was coauthor of a chapter outlining the 5R Instructional Model in *The Handbook of Educational Theories* (Weinburgh and Silva 2013).

Cecilia Silva is a professor emerita at Texas Christian University. Her research focuses on bilingual education, and she is interested in the integration of content to promote literacy and conceptual development. She began her career as a bilingual teacher. Over the past 30 years, she has worked with teacher preparation programs.

Kathy Horak Smith is an associate professor of mathematics at Tarleton State University. Her research has focused on the integration of mathematics and science and communication in the mathematics classroom. She has taught mathematics education courses to preservice and inservice teachers for about 25 years.

Our Stories

We believe that knowing more about us—the authors—will help situate your learning. The stories that follow are meant to provide you with knowledge of how we came together to think about content integration and multimodality.

Our collaboration began when the English as a Second Language director of an urban school district contacted Cecilia and asked for help with writing a three-week summer enrichment curriculum for emergent multilingual learners (EMLs) enrolled in a newcomer's program. This program, structured as a school within a school, sought to gradually transition EMLs into mainstream classrooms. We began our work in the fall of 2006 and taught the first group of students in the summer of 2007 (Silva et al. 2009).

Cecilia (Language)

I have always been interested in the junction of language and content instruction. Coming into this partnership, I was ready to make a contribution to the summer program by drawing on my experiences in thematic unit curriculum development. As a bilingual elementary teacher, I had regularly used thematic units to integrate language and content instruction (Kucer, Silva, and Delgado-Larocco 1995). Thematic units provide EMLs with opportunities to use multiple communication systems (e.g., art, movement, language, mathematics) and various disciplines (e.g., literature, social science, science) to explore meaningful ideas. I also saw that, through integration around themes, I could support EMLs at different levels of language and literacy development yet provide all students with the opportunity to engage in significant curriculum conversations.

At the time I entered this project, I was also exploring the works of authors whose research on academic language was making an impact on practices focusing on content instruction for EMLs (e.g., Gee 2004; Gibbons 2006; Scarcella 2003; Schleppegrell 2004). Newer understandings about the nature of academic language in general and the academic language specific to each discipline were reflected in the *PreK–12 English Language Proficiency Standards* published by TESOL International Association (2006). These standards specifically targeted four core content areas—language arts, mathematics, science, and social studies—and aimed to support academic language development for EMLs at different levels of language acquisition. Through the project, I expected to use this growing body of literature to address students' academic language needs.

As a partner in the collaboration, I wanted to implement sheltered instruction (SI) practices (Diaz-Rico and Weed 2010; Rothenberg and Fisher 2007) that were effective in designing lessons to integrate content and language for EMLs. SI lessons support EMLs through a variety of scaffolds that make content comprehensible while promoting language learning. Early in our discussions about the integration of language and content, Molly and Kathy identified multiple areas in which SI lesson design also served inquiry-based instruction. The development of lessons that build on students' backgrounds and prior learning experiences had a long tradition within their respective disciplines. We also anticipated that the hands-on integrated experiences teachers wanted to bring to science and mathematics lessons would naturally serve to enhance meaning-making for EMLs. Although science and mathematics teachers are not expected to plan student interactions to support linguistic development, Molly and Kathy clearly saw how inquiry-based lessons could be modified to promote language learning.

We also identified areas of conflict between SI and inquiry-based models of teaching, particularly with the Sheltered Instruction Observation Protocol (SIOP) (Echevarría, Vogt, and Short 2000), a model that was gaining popularity at the time. SIOP stressed the front-loading of objectives and vocabulary. In this model, teachers explicitly define, display, and review content and language objectives prior to engaging students in the lesson. Similarly, SIOP emphasizes the preteaching of vocabulary to build background within a lesson. I would learn that this approach conflicts with science inquiry models that stress the need for students to first experience new phenomena through exploration.

Molly (Science)

Cecilia asked me to help develop curricula for the district summer program. I walked into the first meeting with a knowledge of inquiry-based, activity-oriented science instruction and was well steeped in the *National Science Education Standards* (National Research Council 1996). The five essential features of inquiry were second nature to me, as was the 5E learning cycle recommended by the science education community. In addition, I was beginning to read new science education research examining the multimodal aspects of science communication and meaning-making. However, my education as a biology teacher and 18 years of teaching high school resulted in my knowing almost nothing about teaching language skills.

Because I brought a perspective of inquiry-based instruction to the project, I wanted to begin the unit with a question that students could explore over several days or weeks. This would be a question that could be investigated by changing different variables to determine their effect. I wanted a rich environment with access to physical materials that students could manipulate to find patterns, which would eventually lead them to construct explanations for natural events and behaviors. I also needed students to finish the program with a much deeper conceptual understanding as well as an understanding of the roles that both investigations and models play in science.

An early conversation revealed that mathematics was increasingly important in helping students display and make sense of data, so we invited Kathy to collaborate in the project. Our three-way conversations became professional development for us as we learned more about the role we each played in our own disciplines. Language and literacy ideas that Cecilia recommended made sense in many ways, but I was still concerned. As our team continued to read, discuss, and plan, we sought to weave the three disciplines into a coherent unit. We wanted each discipline to be authentically represented.

We began to focus on two ideas: the position of language—especially the complex vocabulary and discourse of science—and the idea of hybrid language (Lemke 2004). We decided to use science as the cornerstone (content area) of the unit and integrate mathematics and language in authentic ways. This was not easy. However, as we looked at the five essential features of inquiry, we saw that each one requires language and mathematics skills and knowledge (National Research Council 2000). Later, *A Framework for K–12 Science Education* (National Research Council 2012) and the *Next Generation Science Standards* (*NGSS*; NGSS Lead States 2013) provided further notions of the practices of science and how language should be included.

Our Stories

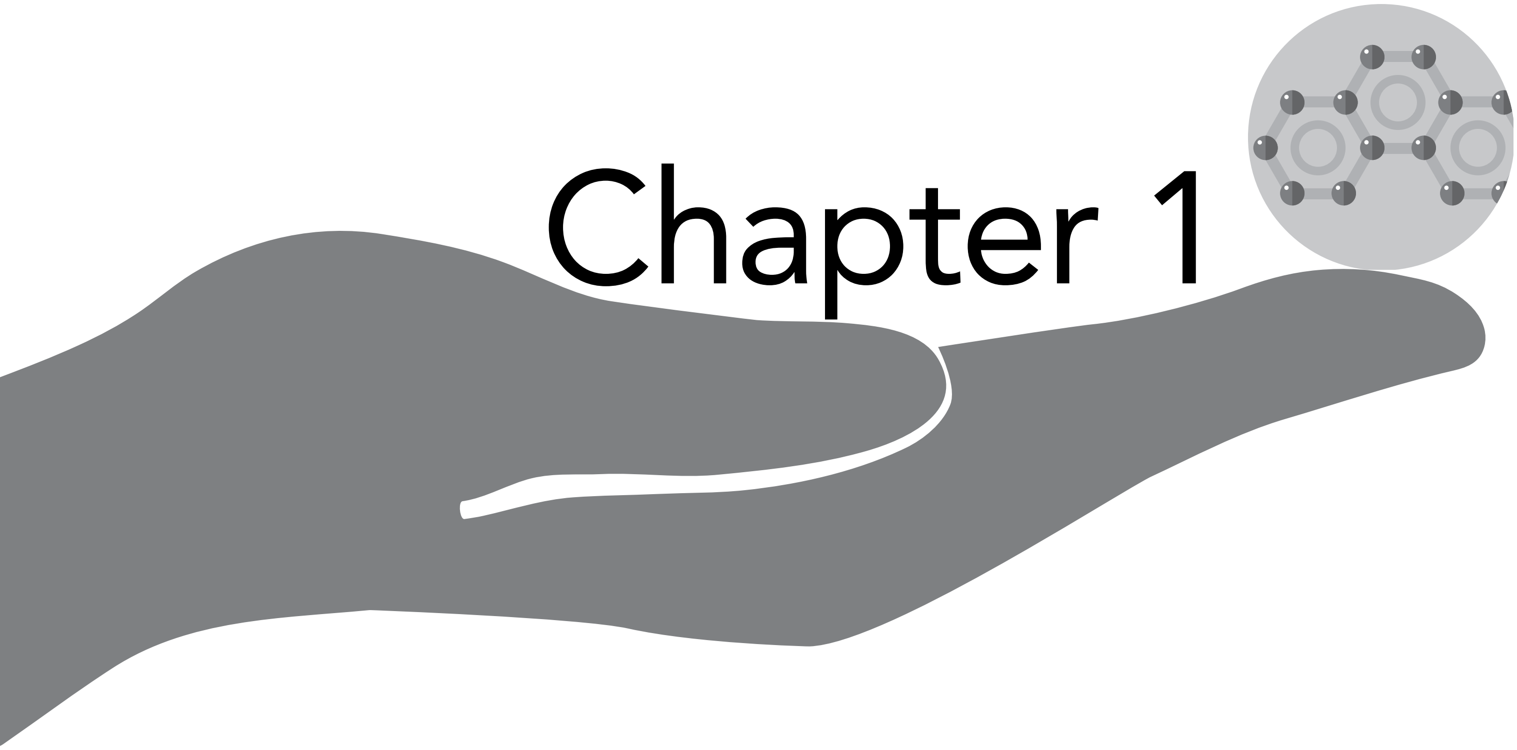
Kathy (Mathematics)

Cecilia and Molly invited me to join the project because of my background in mathematics, my teaching experience, and my love of children's literature in mathematics. At the time, I was interested in learning how students acquire the vocabulary necessary to be successful in a subject. My questions were not derived from working with EMLs but from 30 years of tutoring students who struggle to pass standardized academic tests. I found that students who were in classrooms where academic vocabulary and academic texts were used were still unsure of how to answer vocabulary-rich contextual problems. Even though I knew many students were struggling because of an inability to comprehend what was being asked, I still did not grasp the complexity of academic language.

My interest in developing vocabulary instruction methods was so great that, even before we began the project, I read several books and attended a nationally recognized language integration workshop. At the workshop, the presenters demonstrated literacy strategies for teaching vocabulary in all subject areas and said that objectives and vocabulary should be introduced at the beginning of the lesson. In mathematics—as in science—this approach is seen as "giving away the punchline" when we want students to develop a concept using a social constructivist view. The workshop presenters also discussed the value of "math talk," journal writing, and trade books but failed to help me understand how these strategies develop academic language. I came away from that workshop with many creative ideas but also with incongruences between teaching vocabulary and teaching mathematics using inquiry and problem-solving techniques. I was left in a state of disequilibrium.

Simply introducing new vocabulary at the beginning of a lesson is not the answer. Academic language must be addressed throughout a lesson so that a connection can be made between vocabulary, content, and context. We therefore begin this book with three assumptions. The first assumption is that the 5E learning cycle used in science education is the cognitive model for instruction. The second is that the three dimensions of the *NGSS* (science and engineering practices, crosscutting concepts, and disciplinary core ideas) are evident in science instruction. And the third is that meaning-making is always socially situated and multimodal. These ideas will be revisited and explored throughout this book.

Our journey has not been fast or smooth. It is also incomplete. We have learned and continue to learn from one another and our colleagues, preservice teachers, in-service teachers, and EMLs. Even as we write, we acknowledge that we continue to learn and change. Perhaps most exciting is that the fields of science, mathematics, and language arts focus on communication and emphasize the value of collaboration and integration.



Chapter 1

Introduction

Many middle and secondary science teachers work in schools where English is the primary language of instruction even when it is not the home language of many students. This means teachers often attend conferences to learn new content and language teaching strategies. In the scenario that follows, the teachers are at a National Science Teachers Association (NSTA) conference to learn about the three dimensions of the *Next Generation Science Standards* (*NGSS*; NGSS Lead States 2013): science and engineering practices, crosscutting concepts, and disciplinary core ideas.

> *We attended a regional NSTA conference and were impressed by the number of sessions covering all grade levels and topics. What stood out most was a conversation among a small group of teachers as they stopped for a midmorning break. Our attention was drawn to this group because they were discussing something dear to us.*
>
> *One teacher asked, "How can I do all of these things suggested by the presenter of that last session?"*
>
> *"What do you mean?" came the chorus of responses.*
>
> *"The presenter showed us how to engage English language learners in inquiry. It was great! She posed a question and asked us to brainstorm different ways we could find an answer. We were given materials, and we designed our own ways to find an answer. We talked and laughed and redesigned our setup. We gathered data, displayed the data in a graph, and then compared it to everyone else's work. Throughout the session, the presenter*

engaged us in discussions of how the NGSS stress science for all. She helped us think about how this type of teaching would engage English language learners in rich language and conceptual understanding."

"So what's the problem?"

"The problem is my district mandates a program that requires me to introduce each science lesson with vocabulary. This seems to be the opposite of inquiry. I kept thinking that if our presenter had given us a vocabulary lesson up front, then we wouldn't need to investigate because the definition would have given us the answers. We would have been less creative and seen fewer ways to come to the same conclusion."

"I hear your concern, but I loved the session. I loved that she stressed communication as part of the NGSS practices. Did you notice that she moved beyond vocabulary to thinking about communication? From what we did, I now see science is about communication—not just memorizing words. I'm beginning to think about language differently. I think I can modify the mandated lessons."

Rationale

Teachers such as the ones in this scenario influenced this book. Our purpose with this book is to provide a resource for teachers who are developing science lessons for emergent multilingual learners (EMLs). As explained in the preface, we each came to this work from very different vantage points: science, mathematics, and language. Our work is not just about each of our disciplines. Rather, it is about how those disciplines intersect to support meaning-making within the science classroom.

The strength of our collaboration is in the overlap. It's in the way we each approach our content, view the complexity of integrating content with language, and think about teaching EMLs. Working together, we developed and taught lessons that integrate multimodalities within science inquiry, and we anchored our teaching in the research of others (AAAS 1993; Cummins 1996, 2000; Fang, Lamme, and Pringle 2010; Gibbons 2006; Halliday 1993; Kress 2010; Lee 2005; Quinn, Lee, and Valdes 2012; Saul 2004). In addition, we conducted professional development (PD) with other teachers who were interested in supporting EMLs through the overlap of science, language, and mathematics, and we expanded our teaching and PD with our own research (Silva et al. 2012; Weinburgh and Silva 2011a, 2011b, 2012; Weinburgh et al. 2012; Weinburgh et al. 2014).

In this chapter, we provide context for the intersectionality of language and content by developing an understanding of upper-grade science teachers and students and what they bring to U.S. schools. We follow this with an examination of current learning theory before we return to the conflict between inquiry teaching and language instruction depicted in the opening scenario.

Setting the Context

Who are the teachers?

As a middle or high school science teacher, you were educated to teach content. Your educational background probably did not prepare you to develop skills and strategies for supporting EMLs. You may not have anticipated that you would teach your discipline to students who are also learning English. Your education may have taught you content-specific methods, but it never emphasized the role of academic language within your discipline.

Regardless of your background and current teaching assignment, you are interested in helping EMLs become successful. This means ensuring they can communicate in and about science and can constantly reflect on and clarify their conceptual understandings. In short, you want them to become literate citizens.

Who are the children you teach?

EMLs come from a variety of linguistic, educational, cultural, religious, and socioeconomic backgrounds. Each child, whether he or she is an immigrant, a refugee, or a born U.S. citizen, is a unique mixture of many variables. However, as pointed out by Freeman and Freeman (2009), EMLs who come to middle and secondary school from outside the United States tend to fall into four general categories as determined by English proficiency and educational background. Below, each category is described and an example of a student is provided.

Educated with some proficiency in English. Some students come to the United States well educated in their first language and with some English language proficiency. These students know enough English to begin to interact immediately with other students and in their academic setting. They may not know the culture of U.S. schools, but they have an understanding of schooling. They are literate in their first language and already have a sense of the academic language associated with school learning. They need help transferring their knowledge of specific disciplines to the courses they are taking and building their academic language in English.

Rana, 12 years old, is in sixth grade. She was born in Iraq where her mother was a physician and her father was an engineer. Her family came to the United States when she was 11 years old. She speaks, reads, and writes very well in Arabic. Prior to coming to the United States, she learned some conversational English. Though she is still not fully comfortable with the structure of her new school, she is familiar with the concept of schooling because she attended school in Iraq. She appears to be happy and enjoys reading and soccer.

Educated with no proficiency in English. Other children come to the United States well educated and highly literate in their native languages but with no English language proficiency. These students have a sense of academic language and of the protocols associated with schools.

Juan is 15 years old and attends a newcomer school. His family moved to the United States from Mexico where his mother was a teacher. Prior to immigrating, Juan attended school and is literate in Spanish. He did not have English instruction while in Mexico. He and his family understand schooling and value education. As a ninth grader, all his subjects are taught in English. He is smart, energetic, and full of humor. He enjoys mathematics, plans to go to college, and wants to be an engineer.

Not educated with some proficiency in English. A third group of children comes to school with some proficiency in English but no schooling. These students, who are somewhat fluent in everyday English, have not developed academic language. Because they have limited schooling experience, they are not familiar with general school routines and expectations.

Mohamed came to the United States when he was 16 years old. He completed ninth grade and is a year older than most of his classmates. He was born in Somalia and speaks two languages but does not read or write in either of them. His family lived in one of Kenya's refugee camps before gaining entry into the United States. He learned conversational English while at the refugee camp. Although a happy youth, he has periods when he is quiet and reserved. He likes to play mancala, draw, and swim. He wants to be a professional soccer player when he finishes school.

Not educated with no proficiency in English. The last group of students is made up of children with no English language proficiency and no prior schooling. Therefore, schooling and all the unwritten norms associated with it are new to these students. They often are placed in English-only classrooms where they are expected to become familiar with the norms of school, develop literacy for the first time, learn English, and gain content knowledge of various disciplines. These children may struggle in school because they are learning basic English communication skills on top of the culture and norms of schools.

Mwamba is 13 years old and has just completed eighth grade. He was born in Democratic Republic of the Congo, his family moved to a refugee camp when he was 4 years old, and he came to the United States when he was 11 years old. His family tried to provide him with a basic education, but he has had no formal schooling. Although his history is not completely disclosed, his teachers know that he has seen atrocities to which no child should have been exposed. His mother does not work outside the home; his father works at an assembly plant. He likes to read and do mathematics, and he hopes to one day become a police officer.

For EMLs who are born in the United States, the issues are similar, though many of these children are like the first of the four previous categories. They have attended school in the United States and are familiar with schooling; however, they may still struggle with learning English.

Elizbet was born in the United States. Her family moved to Mexico when she was 9 months old and did not return until she was 6 years old and ready to enter school. Because she has not had access to bilingual classes, she only uses English during school hours. Her family, community, and daily life are almost entirely composed of Spanish speakers. In addition, her family returns to Mexico every summer to stay with relatives. Although she is comfortable with her conversational English, she still struggles with academic English.

For the five students just described, English is both a goal and the language of education. Many teachers can attest to seeing children rapidly become fluent in the everyday language used for interpersonal communication, but studies provide evidence that becoming proficient in academic language takes much longer (Collier 1989; Cummins 1996; Hakuta, Butler, and Witt 2000). Because academic language is complex, Gibbons (2006) suggests that exposing students to the "mainstream classroom without language learning support is an inadequate response to their language development and needs" (p. 5).

What We Know About Learning and Language

A historical examination of learning theory reveals two main views: (1) the transmission model, in which knowledge is a commodity that can be passed from teacher to learner, and (2) the construction model, in which knowledge is put together by the learner with help from the teacher. The former model, which casts the teacher as a giver of knowledge, was the predominant model in the United States until the advent of the progressive movement in the early 1900s. This model has been compared to banking (Freire 1970) where a teacher deposits information into an empty vault (i.e., the student).

In the transmission model, memorization is highly valued, classrooms are teacher-centered, and lectures are the predominant instructional strategy. Embedded in this model is the assumption that communication is essentially a process of information transfer, and language

is a conduit for this transfer. In other words, teachers talk and students listen. Gibbons (2006) suggests this model also assumes that "language must first be 'learned' before it can be 'used'" (p. 17), which results in the separation of language and content.

The construction model stresses the role of the learner as an active participant in the learning process and emerged with the work of Piaget (1951, 1953) and Vygotsky (1968, 1978). Thus constructivism may be divided into two groups: (1) the personal constructivist view (Piagetian) and (2) the sociocultural constructivist view (Vygotskian). Both have greatly influenced curriculum development in science, mathematics, and literacy.

Piaget (1951, 1953) emphasized active inquiry of the student in the construction of new knowledge. As a developmental psychologist, he focused on the intellectual development of children and how learning occurred. His work suggested that transformative learning occurs as individuals construct knowledge and self-reflect. Learning, an iterative process, requires building new ideas upon what we already know. His work posited stages of development that occur naturally and roughly correspond to the maturation of the child. Also important in his theory is the role of firsthand experiences in helping children build new schema or understanding. For Piaget, language was an outcome rather than a cause of development.

By contrast, Vygotsky (1968, 1978) emphasized the role of social situations and culture on learning. He saw learning as a process of negotiating meanings using the cultural tools of signs, symbols, and language. Vygotsky suggested that there is a discrepancy between the cognitive tasks a learner can do on his or her own and those that can be done with the appropriate help of a more knowledgeable other. He called this the zone of proximal development. Within this zone, learners can actively negotiate and construct knowledge if proper scaffolding is provided. For Vygotsky, language is both a cultural tool for communication and a psychological tool for thinking.

We reject the transmission model and build our work on the constructivist perspective. From our backgrounds in three academic disciplines, we find that both the Piagetian and Vygotskyian schools of thought have played an important role in science, mathematics, and language

instruction. We see how these theories complement each other and have influenced the way we think about the intersection of our disciplines. We believe that children need to be active participants in their own learning as they develop with age. At the same time, we understand the critical role of the adult (or more knowledgeable other) in the learning process.

Integrating Inquiry-Based Science and Language: Conflicts and Missing Links

Like the science teachers in the earlier scenario, you may also have attended PD designed to help you provide inquiry-based science experiences that follow the 5E learning cycle. Thus, your lessons begin with exploration and are followed by student-initiated explanations. The emphasis in science on inquiry-based lessons is mirrored in mathematics lessons, which stress manipulatives, exploration, and multiple possible ways to solve a problem. Many teachers voice confusion and concern about teaching science as inquiry because they perceive a conflict between inquiry-based lessons and district-mandated programs that require front-loading vocabulary for EMLs.

These concerns are similar to those cited in the research by Settlage, Madsen, and Rustad (2005), who found that teachers struggled with the misalignment between the Sheltered Instruction Observation Protocol and inquiry-based science instruction. Teachers saw the emphasis on communicating language and content objectives and the front-loading of vocabulary to be in direct conflict with their own understandings of inquiry-based science instruction. They suggest that "a fresh conceptualization of the interface between inquiry-based science teaching and sheltered instruction seems necessary" (p. 39). Articulating the appropriate overlap of these has been noted as a constructive step in making high-quality science instruction accessible to EMLs (Fathman and Crowther 2006; Settlage, Madsen, and Rustad 2005).

We purposely set out to find this intersection between inquiry-based science and sheltered instruction as we taught science to EMLs in a large urban school district. As we began to work together, developing an integrated unit based in science with strong literacy and mathematics components, we found that our disciplines did not meld as easily as we first thought they might. Cecilia came from a language background and, like many of you, was comfortable front-loading objectives and vocabulary before engaging students in an integrated science lesson. Molly and Kathy, who were steeped in inquiry-based instruction in science and mathematics, could not reconcile this into their teaching. The two of them, like many of the teachers we encounter, found front-loading specific objectives and vocabulary to be in conflict with national standards on inquiry-based instruction and investigation.

Vocabulary is important; however, it is only one of many complex features that must be acquired for students to be successful in school. Like many content-area teachers, Molly and Kathy were unaware of the demands that academic language places on EMLs and were not prepared to address those demands in the classroom.

Using our strengths, we designed inquiry-based lessons that built on strong science content and the authentic integration of multimodal language in the classroom. We firmly believe that inquiry-based instruction provides a context in which a deep understanding of both concepts and language can develop. Therefore, we believe the teaching of subject matter content and language should be so integrated that "all content teachers are also teachers of language" (Cummins 1994, p. 42) who "view every content lesson as a language lesson" (Met 1994, p. 161).

Concluding Remarks

Our work required us to look closely at the intersecting space between content and language and how to integrate instruction to provide authentic language-learning opportunities in the inquiry-based science classroom. Our focus has been on how to help students as they strive to make meaning and communicate their understandings in science. To this end, Chapter 2 (p. 9) examines the multimodal nature of the language used in the science classroom, and Chapter 3 (p. 21) examines inquiry-based science instruction. These chapters are followed by our emerging instructional model for thinking about lesson integration design (Chapters 4–9, pp. 35, 45, 57, 67, 75, and 89). Chapter 10 (p. 97) highlights the voices of teachers who have journeyed with us as we rethink ways to support meaning-making for EMLs in inquiry-based science classrooms.

Index

Page numbers printed in **boldface type** refer to figures or tables.

Index

Index

Index

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"We firmly believe that inquiry-based instruction provides a context in which deep understanding of both concepts and language can develop."

—From the Introduction

Many middle and high school teachers are educated to teach science content—they don't anticipate that one day they may be teaching it to students who need to learn both the content *and* English. If the day has come when you're facing that two-pronged challenge, here's the resource you need.

Supporting Emergent Multilingual Learners in Science combines science-teaching strategies with down-to-earth help for emergent multilingual learners (EMLs). Grounded in solid research, this book shows you how to put into practice the 5R Instructional Model: Replace, Reveal, Repeat, Reposition, and Reload. It's a framework for creating instructional strategies that provide authentic language-learning opportunities within your inquiry-based science classroom.

This book begins by laying out the need for a special approach to integrating science and language and also outlines the 5R model. It then moves from theory to practice by focusing on each of the five *R*s and showing how they play out in specific situations.

The book ends with "Voices From Teachers," offering examples from actual classrooms so you can learn from experienced colleagues how the 5R model works as a tool to develop science lessons.

The authors of *Supporting Emergent Multilingual Learners in Science* have diverse backgrounds in science, mathematics, and bilingual education. Drawing on the intersection of these areas, they show how you can reduce conflicts and enhance connections between inquiry teaching and language instruction. The authors know, as they write in the book's introduction, that "regardless of your background and current teaching assignment, you are interested in helping EMLs become successful."

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