REGION IX EQUITY ASSISTANCE CENTER AT WestEd

Equal Access to Content Instruction for English Learners

An Example from Science

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Acknowledgements

This report reflects the work of a team from the Region IX Equity Assistance Center at WestEd: Rose Owens-West, director; Virginia Davis, writing coordinator; Janice Lowen Agee, editor; and Delphean Quan, program assistant.

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While we recognize the progress brought about by enforcement of the civil rights laws, problems persist in the denial of full educational opportunities to persons with disabilities, racial and language minorities, females, and older Americans. A commitment to the goals of the civil rights compliance program—equal access, educational excellence, and high standards for all students—is an investment that we must make if we are to secure America's future (U.S. Department of Education, 2011, p. 9).

Equal access to content instruction is the foundation of educational equity—it reduces opportunity gaps that lead to achievement gaps. Achievement gaps lead to gaps in college and career access, which lead to income gaps. Income gaps lead to language gaps, thus perpetuating one of the most critical gaps we face in education. This paper is about the importance of equal meaningful access to content instruction for English learners and how academic-language instruction through content improves both content and English achievement. In this paper we use quality science education as an example of providing meaningful access to content instruction through hands-on, inquiry-based lessons to apply higher-order thinking skills that promote the development of academic language. We conclude by advocating that this type of science education should be available to all students and suggest policies and practices to increase the likelihood of this taking place.

Do English Learners Have Equal Access to Content Instruction?

English learners are students in U.S. schools whose first language is other than English and who are in the process of learning English. These students include those who are just beginning to learn English as well as those who have developed considerable proficiency. English learners are a heterogeneous group of students, coming from diverse linguistic, economic, and educational backgrounds. They can be newcomers, with various levels of prior schooling, as well as students born and educated in the United States.

State-approved oral language and literacy assessments determine that these students lack the clearly defined

English language skills of listening comprehension, speaking, reading, and writing necessary to succeed in the school's regular instructional programs. Federal legislation (Elementary and Secondary Education Act, 2002) provides additional funds (Title III) for schools to ensure that English learners attain English proficiency and meet the same challenging academic content standards that other students are expected to meet.

Equal educational opportunities can be provided for English learners through instruction in English language development (ELD) or English as a second language, combined with engaging content instruction using specific techniques to make content comprehensible and usable. Both of these instructional opportunities should be provided simultaneously. Leaving the latter until English learners have sufficient English proficiency automatically relegates the students to a second-class citizen role, where they are “disadvantaged” and have “deficits” because they lack content instruction and content knowledge that they are expected to master at specific grade levels. Both **ELD** and **comprehensible content instruction** are required.

English language learners face the dual challenge of acquiring content knowledge and academic language. Without proper instruction, the language demands of content disciplines can compromise English language learners’ content understanding. However, teachers can make content instruction accessible through scaffolding. Scaffolding is an instructional strategy that involves supporting novice learners by limiting the complexities of the context and gradually removing those limits as learners gain the knowledge, skills, and confidence to cope with the full complexity of the context (Young, 1993). In other words, scaffolding amplifies the language of content. Examples of scaffolds include using concept maps, t-charts, graphic organizers, illustrations, and realia; pre-teaching appropriate vocabulary; fostering collaborative projects that involve content specific conversations; and using paragraph starters and sentence frames in developing writing skills.

Carefully crafted instruction can not only obviate many of the obstacles that English learners face in learning, but it can also have particular benefits for their development of academic English language and their ability to navigate the reading and writing assignments that shape their school lives (Lee & Luykx, 2006; Cervetti, Bravo, Duong, Hernandez, & Tilson, 2008). By employing appropriate techniques that increase students’ use of oral language and meaningful use of academic language, content area teachers provide a level playing field on which English learners can achieve.

What Is Academic Language?

Academic language, simply put, is school language. It is the language that is valued by teachers, texts, and tests (Zwiers, 2008), and without it, student achievement is compromised. Academic language is different in structure and vocabulary from the spoken English of everyday interactions, with longer, more complex sentences that contain less frequent vocabulary than are found in spoken English (Bailey, 2007; Schleppegrell, 2004).

Many students who appear to speak English well have trouble comprehending this “school language.” The vocabulary and complex grammatical constructions found in academic language can inhibit comprehension and learning from lectures and texts.

We divide academic language into its three components: (1) vocabulary related to the academic content domain; (2) general academic vocabulary related to the words used within the discipline to tie ideas together; and (3) sentence structures required by the content discipline. For example, in an elementary unit on the life cycle of butterflies, words like *egg, caterpillar, chrysalis, larvae*, and *pupa* would be labeled as vocabulary related to the academic content. Words like *grow, change, emerge, molt*, and *transform* would be considered general academic vocabulary that would tie the discipline-specific ideas together: “The chrysalis transforms into an adult butterfly." Words that sequence ideas, such as *first, then, next, last*, and *finally*, as well as those that describe cause and effect, such as *if... then*, are used in sentence structures required by the content discipline to increase content understanding (e.g., "A butterfly begins as an egg, then develops into a larvae called a caterpillar. Next it becomes a pupa called a chrysalis. Last it transforms to a butterfly").

Some language development professionals use the analogy of "bricks" and "mortar" to differentiate between the content-specific vocabulary (bricks) and the general academic terms (mortar). Both are important for language development. For example, mortar words, like *therefore, however*, and *because*, can be used to create coherent and logical sentences about the brick words like *pendulum, pressure*, and *organism*. Thus, the classroom becomes a place where students are engaged in the integrated learning of content and language through meaningful experiences, in conjunction with scaffolding by teachers **and** peers of the features of both spoken and written academic language that are needed to construe meaning (Heritage, Silva, & Pierce, 2007).

Why Does Academic Language Matter?

Beyond remembering factual knowledge, cognition requires understanding and application of knowledge. Accomplished learners know when to ask a question, how to challenge claims, and where to go to learn more; they are aware of their own ideas and how these change over time (Duschl, Schweingruber, & Shouse, 2007). But for students to engage in this type of thinking, they need academic language.

Academic language is based on two primary factors: life experiences and school opportunities. It is well documented that students from middle-class, English-speaking families have life experiences that are more closely related to academic literacy and school-like conversations than do students from low-income, non-English speaking families. Middle-class children, in general, know how to ask questions, ask for help, and get support, and they have large vocabularies. Lower income children (many English learners are also low income) often lack these language skills (Hart & Risley, 1995), particularly those that are important for learning, speaking, reading, and thinking. These students have not been immersed, as have their middle-class counterparts, in the language of schooling.

Yet research (Bransford, Brown, & Cocking, 2000) indicates that all learners can move from novice to expert when provided with appropriate learning opportunities. We know that adults play a central role in "promoting children's curiosity and persistence by directing their attention, structuring their experiences, supporting their learning attempts, and regulating the complexity and difficulty of levels of information for them" (p. 223). Thus, school is a perfect place to promote quality language (and content) learning.

Unfortunately, in too many low-income, low-achieving schools with large English learner populations, pacing guides rule the instructional clock. With an emphasis on covering the mathematics and English language arts standards, time for other curricular areas has diminished, including the core subjects of science and history/social science. In the newly released report, *High Hopes, Few Opportunities: The Status of Elementary Science Education in California*, the authors note that 92 percent of the responding elementary teachers stated they had only a limited time for science, and 81 percent noted that the emphasis on English language arts and math made finding time to teach science difficult. The situation was exacerbated in low-income schools—principals of affluent schools were two times more likely to embrace science initiatives at their schools (Center for the Future of Teaching and Learning at WestEd, 2011).

In negating students' opportunities to engage in subjects like science and history/social science, we have decreased the rich opportunities for students to be engaged in meaningful discourse and have lowered their opportunities for building academic language. By ensuring that all students can be engaged in science, we restore these learning opportunities.

Is Science a Way to Academic Language?

Science is "both a body of knowledge and an evidence-based model-building enterprise that continually extends, refines and revises knowledge" (Duschl et al., 2007, p. 2). The language of science is grounded in describing what happens in the natural world and in finding cause and effect relationships using claims and evidence. Science writing often involves procedural language and use of objective evidence to draw conclusions, as well as the use of charts, diagrams, and graphs to display data. Both oral and written scientific communications include the importance of scientific argument as a "habit of mind." Scientists ask questions of each other: What do the data show? What other factors might have impacted the results? How do these findings compare with other scientific knowledge? Thus, the language of science involves a wide range of conceptual understanding, academic language, and thinking skills.

Educators can build on the nature of science through scientific inquiry in the classroom. Through hands-on, inquiry-based science instruction, students develop knowledge and understanding of scientific ideas; learn how scientists study the natural world; and gain experiences in speaking, listening, writing, and reading, which build academic language to enhance their understanding. Scientific inquiry provides rich opportunities for problem solving, decision-making, communication, and high-level thinking skills that students need to become productive citizens in the 21st century. Engaging in scientific inquiry helps students acquire knowledge about "ways of being in the world, ways of acting, thinking, interacting, valuing, believing, speaking and sometimes writing and reading" (Gee 1992, p. 73), all of which contribute to building academic language.

Science and literacy have a natural link in the real world as scientists depend on oral and written communication, reading, and the use of literacy skills for scientific argumentation. In schools, reading and writing are constitutive parts of science (Norris & Phillips, 2003). Science can be constructed, reconstructed, transformed, and applied through the tools that we associate with literacy, defined as the capacity to use language in various forms to think, analyze, and communicate (Miller, 2009).

The use of English forms (e.g., grammatical features) and functions (i.e., the task or purpose, such as contrast) fits nicely with the science thinking processes (e.g., describe, observe, analyze, summarize, evaluate, cause and effect). If one function of academic language is to describe complexity, promote higher-order thinking, and enable abstraction, then science is the perfect context to develop academic language. For example, abstraction can depend on cause and effect, interpretation, and comparison. Scientific inquiry is grounded in these abstractions.

Language learning is integral to, not separate from or prior to, the development of thinking (Heritage et al., 2007). Language production (oral and written) is the vehicle humans use for expressing thoughts. Oral language is a primary way in which meaning gets constructed and built. Through talk, we come to understand concepts and our interpretations and ownership of ideas (Hiebert, 2009). Students need academic time to produce longer stretches of academic talk, including time for student discourse and teacher modeling of language use. Providing scaffolded opportunities to get thoughts on paper further establishes academic-language skills and gives expression to thoughts. Science experimentation and investigation, with their claims and needs for supporting evidence, provide these opportunities. Gomez-Zwiep and her colleagues (2011), in their blended science and language work with Montebello schools, describe these opportunities. "Sources of language (e.g., teacher talk, peer talk, text) were explicitly embedded within tasks and supported by strategies that ensure comprehensibility" (p. 777).

Can It Be Done?

Current research in the field suggests that science instruction can lead to increased student performance in reading, writing, and science. Moreover, integrating science and language accelerates the development of academic English, allows English learners to have equitable access to content curriculum, and supports culturally and linguistically inclusive classrooms (Carr, Sexton, & Lagunoff, 2007). Because of the connection between science and literacy, many educators and scholars are attempting instruction that integrates these two areas (Lee & Luykx, 2005; Stoddart, Pinal, Latzke, & Canaday, 2002; Yore, Florence, Pearson, & Weaver, 2006; Gomez-Zwiep, Straits, Stone, Beltran, & Furtado, 2011).

The U.S. Department of Education, Institute of Education Science's recent publication evaluating the effectiveness of Alabama's Math, Science, and Technology Initiative (AMSTI) provides evidence that engaging, meaningful access to content instruction—through hands-on, inquiry-based science and math lessons that apply higher-order thinking skills—leads to higher English reading achievement on the Stanford Achievement Test (Newman et al., 2012). This result may be due, in part, to the complex relationship between language and thinking that this type of instruction fosters as well as the engaging nature of the subject matter. Indeed, "…the willingness of students—especially young adolescents who are ELLs [English language learners]—to really express themselves orally and in writing depends on appropriate and compelling topics" (Hiebert, 2009). AMSTI science teachers were more likely to report higher levels of student engagement than control group science teachers, with these differences being statistically significant.

Through an Improving Teacher Quality Grant from the California Postsecondary Education Commission, WestEd's K-12 Alliance, in conjunction with the California State University at Long Beach and Montebello Unified School District, developed and implemented a science and English academic-language program at three elementary (K-4) schools with high English learner and low-income student populations. Initial agreements included:

- Science thinking skills mirrored functional purposes of using language.
- Science content could provide a high-contextualized setting for language development.
- Non-English proficient students could still process science content at a high cognitive level (and therefore content would not be simplified to simplify language).
- Academic vocabulary, along with specific language functions and forms, would be used appropriately for their purpose (i.e., which new words would be embedded and which would be front-loaded depended on the lesson's instructional goals).

Through much trial and error, the program moved from the separate disciplines of science AND language (in which teachers tended to either focus on language and ignore science or vice versa) to a blend of the two. In this blend, student thinking was considered first, and authentic language (language built from the science learning experience) development occurred as the students described their thinking. This method shows how content-area teachers can appropriately scaffold their instruction to make content comprehensible to English learners while also increasing students' opportunities for language use in the content area. As Gomez-Zwiep et al. (2011) summarize,

> [I]f students were asked to recall information about rocks in the **engage** stage, but to compare and contrast properties of rocks in the **explore** stage, appropriate teacher prompts and student frames were designed in each section. This allowed for more specific language support, making it easier for teachers to engage students with limited-English skills in more scientifically-rich conversations and

activities (p. 776).

Insights gained from this project can inform others who need to make science instruction comprehensible and increase opportunities for language development in their classrooms. One insight was that teachers recognized that English learners need various types of language supports to help them express their new science knowledge. For example, teachers learned that sentence frames often limit student responses (same frame yields similar responses), resulting in student work that does not show a range of student conceptual understanding. Teachers also found that they needed additional ways to increase student understanding that are appropriate at various levels of language development, "such as providing realia or pictures and asking students to make concrete observations, to physically manipulate materials, or to draw one or a sequence of diagrams to express their thinking" (p. 778).

Another insight was the recognition that science is a natural motivator. By appropriately blending science instruction with scaffolds that provide content access to English learners, and providing time to teach it, the status of science is increased, and student motivation increases. More importantly, students talk about science, resulting in an increased use of English and academic vocabulary. "You should see the vocabulary they (students) now use, 'we predicted today, we did some observations.'" (p. 780). Additionally, students begin to increase their use of English in other classrooms as well in non-classroom settings, such as in the office or library.

Lastly, teacher perceptions of English learners' abilities changed along with their curriculum and instruction. All participating teachers commented on the changes they have seen within their own teaching practices, most prominently in terms of raising their expectations of English learners. Teachers now focus on what students can do rather than what they cannot do. As one teacher said, "Even my low [English learners] can verbalize these science things. You have to expect them to because sometimes it's just the language and not that they aren't thinking these things in their minds" (p. 781).

The connection between school science and academic language is complex. As "higher-order thinking" requires "higher-order language" (aka academic language), meaning-based, engaging, language-rich, inquiry-based science fosters these complex skills.

Why Is Access to Science the Key?

Students who are not exposed to science miss many opportunities, including the chance to explore, experiment, create, and build understanding. For the English learners assigned to more instructional minutes in English language arts or more time for math, little time is left for science. "Too often these students must wait until they develop fluency before they are provided access to science content, leaving them years behind their English speaking counterparts, struggling to catch up" (Gomez-Zwiep et al., 2011, p. 783). These gaps affect English learners' abilities to engage in science, technology, engineering, and math (STEM)-related opportunities and careers.

Access to content knowledge, also known as opportunity to learn, is directly related to content-area as well as verbal (English) achievement. Science requires using specialized vocabulary, syntax, and discourse features. Students need to start early to learn the specific academic forms of the academic discipline's language, or they will have great difficulties in the later grades where language demands in the content areas become intense and complex. English learners need to be successful in all components of academic language. If they are not proficient in academic language, they are less likely to understand content-area instruction or be successful learners.

Without access to classroom science instruction that focuses on both language and content objectives, English learners in K-8 fall behind, resulting in inadequate preparation for high school coursework and poor performance on both verbal and other content-area, high-stakes tests (e.g., Programme for International Student Assessment [PISA], Third International Mathematics and Science Study [TIMMS], National Assessment of Educational Progress [NAEP], and state English and science assessments).

Content exposure is a significant predictor of students' test scores. Less science educational opportunity in elementary and middle school leads to poor test scores, which in turn leads to less rigorous science curricula in high school. Less rigorous science curricula lead to lower college entrance exam scores, less chance of completing a bachelor's degree, and, eventually, lower economic attainment throughout life.

College entrance is determined by many factors, including scores on entrance exams and access to rigorous coursework in high school. As indicated in Table 1, students from other-than-English-language backgrounds, many who were English learners (e.g., Mexican, Puerto Rican, and other Hispanic students), as well as Black students, who may speak a non-standard, non-academic dialect of English, score lower in SAT language assessments (critical reading and writing) than White students, most of whom are native speakers of standard, academic English. SAT verbal scores significantly influence college admission decisions, and, therefore, a student's access to earning a degree.

Table 1: Total SAT Mean Scores by Ethnicity 2011

SAT	Test-Takers		Critical Reading		Mathematics		Writing	
Test-Takers Who Described Themselves As:	Number	Pct	Mean	SD	Mean	SD	Mean	SD
American Indian or Alaska Native	9,244	1	484	106	488	105	465	102
Asian, Asian American, or Pacific Islander	183,853	11	517	125	595	125	528	127
Black or African American	215,816	13	428	98	427	97	417	94
Mexican or Mexican American	99,166	6	451	97	466	97	445	92
Puerto Rican	26,520	2	452	103	452	104	442	101
Other Hispanic, Latino, or Latin American	127,017	8	451	104	462	105	444	102
White	865,660	53	528	103	535	102	516	103
Other	58,699	4	493	121	517	120	492	119
No Response	61,148	4	448	129	496	126	450	123
Total	1,647,123	100	497	114	514	117	489	113

The College Board. Table 8.

Additionally, the rigor of a student's high school curriculum is the best predictor of whether that student will earn a bachelor's degree, regardless of the student's race/ethnicity or socioeconomic status. Access to rigorous high school courses is a measure of a school's capacity to prepare students for college and life beyond high school. As displayed in Table 2, the number of years of science study for high school students is directly related to achievement on college entrance exams (Adelman, 1999, 2006); students with fewer years of science score lower than those students with more years of science. Smaller proportions of Hispanic and Black students tend to complete advanced science courses (e.g., Physics) in high school, compared to White and Asian students (Bridgeman & Wendler, 2005).

Table 2: Total SAT Mean Scores by Years of Science 2011

Natural Sciences	Test-Takers		Percent by Gender		SAT Mean Scores		
Years of Study	Number	Pct	Male	Female	Critical Reading	Mathematics	Writing
More Than 4 Years	176,166	13	47	53	538	573	533
4 Years	637,646	48	46	54	517	530	508
3 Years	379,710	28	44	56	479	485	469
2 Years	82,951	6	47	53	469	481	459
1 Year	30,465	2	47	53	463	480	452
1/2 Year or Less	32,143	2	45	55	431	455	424
No Response	308,042		51	49	474	503	470
AP/Honors Courses	449,974	34	45	55	565	584	556
Course Work or Experience							
Biology	1,243,479	96	45	55	503	516	494
Chemistry	1,145,241	89	45	55	509	524	501
Physics	665,633	51	49	51	523	548	515
Geology, Earth, or Space Science	595,463	46	46	54	487	496	476
Other Sciences	478,194	37	41	59	493	502	483

The College Board. Table 16.

What Are the Emerging Opportunities?

The emergence of the Common Core State Standards and their emphasis on readiness for careers and college create an opportunity for learning that truly resonates with rigor and relevance. The standards provide opportunities for students not only to acquire and assimilate information, but also to apply the information to new situations and think in complex ways. Two key shifts presented in these standards favor coupling science and English language arts: (1) the increase in non-fiction texts; and (2) content-area literacy standards. Both of these shifts make clear the importance of embedding English academic-language skills in the context of science, history/social science, and other technical subjects. Students need to be able to write reasoned arguments, defend positions with evidence from text and other resources, and solve real-world problems. What better way than through inquiry-based science!

The Next Generation Science Standards, due out at the end of 2012, also add to the importance of combining science and English academic language. These standards call for the integration of science and engineering practices, core ideas that span K-12, and crosscutting concepts. Implicit in each of these practices and concepts is the need for oral and written communication, and the ability to gather and use information appropriately.

Both the Common Core and the Next Generation Science Standards also support the movement for 21st century skills that will enable students to meet workplace demands. These skills include proficiency in complex communication, non-routine problem solving, self-management, systems thinking, and information and technology fluency.

Lastly, the current call for recognition and stepped-up implementation of STEM education provides an avenue to place these subjects on the "front burner" of student learning. There are many reasons for STEM being on center stage—including the global economy, employment, and the health of our planet. Perhaps the most important is that STEM's academic language leads to critical thinking and problem solving that will help move our country into the 22nd century.

What Will It Take to Increase Students' Access to Science?

Changes in policies and practices

- To maximize the opportunities to restore science as a core content area and increase opportunities to develop academic language, policies and practices need to change at the national, state, and local levels. Nationally, the inclusion of science literacy in the Common Core State Standards and the debut of the Next Generation Science Standards have helped to set a national agenda for science. Next, there needs to be a change in national and state policies to require performance in science as one indicator in accountability systems. When this happens, local accountability systems and instructional offerings need to reflect the change.

- New instructional materials, including standards-based curricula, need to be developed to reflect the standards and the type of pedagogy that supports thinking, problem solving, and decision-making. These materials need to include both academic language and science objectives.
- While state educational codes may not mandate instructional time requirements for science, school district policies and practices need to ensure the following: (a) that all students have access to science curricula; and (b) that curriculum guides provide time for inquiry-based science to develop conceptual understanding and academic language.

Changes in Professional Development

- Increasing students' science knowledge and skills, as well as building their academic language, can only happen if teachers are highly qualified in the content and language domains. What is required is professional development in both science content knowledge and academic-language content that addresses how to successfully engage all students in learning academic (e.g., science) content and language through planned, focused, scaffolded instruction. This type of professional development needs to occur at both the pre-service and in-service levels. The goal of this professional development would be to create science classrooms in which teachers and students are engaged in building content, language, and thought.

These are exciting possibilities for changing the way we do business in schools to provide students with the academic language and science knowledge they need to reach their potential. When we focus on these changes, all students, regardless of language status or linguistic background, will have access to high-level, rigorous instruction that develops both language and thought.

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