Myths about English language learning: Implications for science instruction in light of the Next Generation Science Standards.

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As the ethnic and racial diversity in U.S. classrooms continues to grow, myths about the education of English Language Learners (ELLs) persist, while many teachers feel ill-prepared to meet these students’ academic needs (Laborin Gomez and Jimenez Silva 2010). This article focuses on myths shared by in-service science teachers enrolled in a master’s program at the University of Texas at El Paso on the Mexican border. We asked these teachers to describe at least one myth about second-language acquisition they had encountered. This article discusses their responses and offers strategies teachers can use to address these myths based on our previous work with ELLs and the Project Citizen curriculum (Center for Civic Education 2014).

**Background**

Learning a second language (L2) is a demanding task for students. Learning science at the same time is even more demanding. These students must traverse the distance from their native language (L1) to their second language (L2) and from basic interpersonal communication skills (BICS) to cognitive academic language proficiency (CALP). Given the increasing numbers of English language learners in the classroom, a figure reaching 4.4 million in 2012 (National Center for Educational Statistics 2014), some science teachers are expected to also serve as language teachers, making the language of science a kind of third (academic) language (DeLuca 2010). Following are strategies to help science teachers do just that.
Myth 1: Teaching science to ELLs means only focusing on vocabulary

The first myth teachers reported was the assumption that students will learn scientific ideas simply by engaging in activities loaded with vocabulary terms. The Next Generation Science Standards (NGSS Lead States 2013) require all students, including ELLs, to move beyond understanding individual vocabulary words. The standards emphasize that students engage in Science and Engineering Practices and use science language to communicate their understanding (Krajcik 2013; Lee, Quinn, and Valdés 2013), including constructing explanations and engaging in argument from evidence (practices 6 and 7).

The good news for those who hold Myth 1, however, is...
that research demonstrates that native English speakers and linguistically diverse students are equally capable of learning scientific concepts and terminology through “collaborative talk” in inquiry-based experiences (Simich-Dudgeon and Egbert 2000). These are student-teacher and student-student conversations in which participants join forces to attain outcomes at the highest possible level. They can be as simple as deciding on the number of tests to be included in the experimental design or debating whether the gathered evidence supports their claims (Simich-Dudgeon 1998). Likewise, other research contends that “when supported appropriately, most ELLs are capable of learning science through their emerging language using less-than-perfect English” (Lee, Quinn, and Valdés 2013, p. 227).

**Ways to address this myth**

**Activating prior knowledge and using tiered vocabulary**

The use of scientific terminology “is the principal barrier to conceptual understanding for ELLs” (Crowther et. al. 2011, p. 17). One way to address this challenge is to activate students’ prior knowledge and home language and practices, which can help move them from simple word recognition to conceptual learning (Dong 2013). For example, teachers can administer a Previous Learning Survey or conduct an Appreciative Interview to access this information before starting a lesson or thematic unit (Figure 1).

Also helpful is the tiered approach to vocabulary instruction, in which students use terms they are familiar with in everyday life (tier 1), and then move on to those that are considered sophisticated (tier 2) and specialized (tier 3). Figure 2 addresses a lesson plan that follows the 5E model (Bybee 1993), using the BICS/CALP language developmental patterns and the three-tiered vocabulary system.

Informal-to-formal instruction is another way to help students as they begin their interactions with content using colloquial language; volunteer their own examples, definitions, and explanations (Carr, Sexton, and Lagunoff 2007); and gradually move into the language of science (Quinn, Lee and Valdés 2012) (Figure 3, p. 56). This vocabulary instruction, coupled with science and engineering practices such as Planning and Carrying Out Investigations; Constructing Explanations; Engaging in Argument from Evidence; and Communicating Information, can be the focus of a student-generated project. Perhaps students want to investigate the organic food industry’s influence on public perception of food safety. Students can practice tier 1 (e.g., diet) and tier 2 (e.g., additives) terminology as they engage in “collaborative talk” in the early stages of their study. For instance, they might design and administer, in their L1 if necessary, a survey of opinions about organic food in their community. They can then use sophisticated tier 3 terminology (e.g., gluten, protein, or metabolism) as they gather background information on the issue, analyze the data, and communicate and discuss their findings in the classroom.

**Competent outsiders and citizen science**

A recent issue of the journal *Science* discussed family members in the ELL population as “competent outsiders” (Feinstein 2011). This perspective sees ELLs as individuals who “can access and make sense of science relevant to their lives” (p. 314), using prior understandings and practical experiences to help make sense of scientific phenomena. Tapping into this background knowledge takes more planning on the teacher’s part, but local institutions and national government or community organizations can provide additional resources and learning opportunities for ELLs to practice using scientific terminology.

One well-known strategy often associated with citizen science is the investigation of socio-scientific issues (SSI). For example, in Project Citizen (PC) (Center for Civic Education 2014), students learn scientific language by dealing with problems in which they “work with each other, teachers, and volunteers as they identify a problem to study, gather information, examine solutions, develop public policy positions, and create action plans” (Green and Medina-Jerez 2012, p. 59). One such PC project that meets the standards outlined in Figure 3 might have students investigate the incidence of respiratory illnesses in heavily trafficked neighborhoods.

First, students identify a problem that can be studied through public policy (e.g., U.S. Environmental Protection Agency air pollutant criteria). Second, they decide on a researchable question worth investigating. Their investigation might use second-hand data reported in the news (e.g., cases of asthma vs. ambient nitrogen dioxide [NO2] measurements in the last 10 years).

Third, they gather background information as they delib-
erate, analyze, and interpret the data. Here, students are afforded a collaborative learning opportunity to practice pertinent tier 1, 2, and 3 terms (e.g., pollution, emissions, and acute), use their L1 to refine their understanding of the issue under investigation, and identify relationships that may help them understand the circumstances (i.e., variables) surrounding the occurrence (or not) of asthma cases in connection with NO2 concentrations. In this stage, students use evidence to propose models that support their explanations. Finally, they assemble a project portfolio or documentation binder that may include measurement notes, communication with government agencies, and copies of surveys administered to local residents. In this phase, students can also construct a display panel that

- explains the problem,
- suggests alternative policies (e.g., restrict commercial traffic in certain areas or times of the day),
- develops a public policy (e.g., enforce an existing environmental policy), and
- creates an action plan that explains, in a public hearing, how they will get the proposed policy adopted by the appropriate governing agency.

In our work with PC projects, we have seen our ELL students experience firsthand the science and engineering practices of identifying, evaluating, and communicating information; presenting arguments with evidence; and designing solutions. Students typically begin the project with their own investigation, perhaps in their less-than-perfect language, understanding and gradually refining their proficiency both with the content and the language of the lesson or thematic unit.

Teachers can find numerous common “manifestations of science” in daily life activities, such as agricultural practices (e.g., the effects of pollutants present in agricultural runoff),
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food choices (e.g., Should we buy organic products only?), and health-related issues (e.g., What causes diabetes? How can I avoid it?), that most students, including ELLs, have encountered. Figure 1 provides additional strategies for rich science language instruction as an alternative to exclusively focusing on vocabulary.

**Myth 2: ELLs cannot learn the English language while learning science content**

Another myth teachers reported is that ELLs should learn the language (L2) first and the science content second. In other words, many believed ELLs could not learn English and science simultaneously. However, science—rife with opportunities for hands-on learning—provides a rich context to support academic language development. Although it requires substantial time and support to develop (Hakuta, Butler, and Witt 2000), academic language proficiency is critical to students’ success in science and in school. *Scaffolding* is the term used for the language routines that help ELLs acquire CALP—and is one way teachers can address this second myth. Scaffolding involves the “techniques teachers use to temporarily support students while they build new science skills and knowledge at a higher level than they could reach without assistance” (Carr, Sexton, and Lagunoff 2007, p. 55). In Figure 4, we provide seven strategies for scaffolding science learning for ELLs.

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<th>Teacher-student activities</th>
<th>Student activities</th>
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<td>- Cues ¹</td>
<td>- Visuals ¹</td>
<td>- Think-pair-share ¹</td>
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<td>- Think aloud ²</td>
<td>- Summarizing ²</td>
<td>- Reciprocal teaching ²</td>
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<td>- KWL+ ³</td>
<td></td>
<td>³ With <em>think aloud</em>, the teacher verbalizes her or his own thought process while reading aloud, showing a video, or conducting an experiment. ³ In <em>KWL+</em>, the teacher starts the lesson addressing what students know (K) and want to learn (W) about the topic, and end by recording the learning (L) that took place. The ‘+’ refers to the connection among the three categories. ³ Visuals include nonlinguistic representations (e.g., photos and realia). ² Summarizing involves the use of notetaking techniques modeled by the teacher.</td>
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1. *Cues* are usually found in three forms:
   - Hints, which are used to preview learning;
   - Questions, which are used to reinforce information and check for understanding; and
   - Advance organizers, which help students interact with information in upcoming lessons.

2. With *think aloud*, the teacher verbalizes her or his own thought process while reading aloud, showing a video, or conducting an experiment.

3. In *KWL+*, the teacher starts the lesson addressing what students know (K) and want to learn (W) about the topic, and end by recording the learning (L) that took place. The ‘+’ refers to the connection among the three categories.
Though ELLs pick up BICS relatively quickly, research shows that reaching CALP takes as long as 7–10 years for those with limited prior schooling (DeLuca 2010). Scaffolding helps students as they acquire CALP and inquiry science skills. Sample scaffolding activities include Gallery Walks or Inductive Outings (outdoors) to survey animal or plant species. Students record careful observations in their notebooks, labeling each part of their sketches. Through this task, ELLs practice precision in using science language, being careful with word choice as they illustrate their observations and in their attempts to explain phenomena. Students can work in small groups to proofread their entries, get support from bilingual classmates, or use Spanish-English (for example) or English-English dictionaries. Nevertheless, the teacher “needs to mediate discussions to ensure that poorly expressed ideas are heard and considered by others, not to ensure that students speak correctly” (Quinn, Lee, and Valdés 2012, p. 9).

For example, in the context of a PC project, students can work collaboratively to gather information on an SSI (e.g., the effects of some animal species’ overpopulation). Completing a mid- to long-term project, students can practice their knowledge of science by studying public policy, researching the literature, processing and interpreting data, weighing evidence, developing explanations and action plans, and communicating their ideas to their classmates, decision makers, and interested parties. Figure 5 describes other strategies for simultaneously fostering learning of the English language and science content.

**Conclusion**

Science instruction can be a rich context for students to practice reading, writing, speaking, and argumentation skills. The NGSS emphasize science language as a vehicle for students to understand scientific ideas. For science teachers, this means promoting precise language usage. This requires a classroom culture where all views and voices are heard and taken into consideration, regardless of grammatical flaws. One practice that should be at the forefront of each lesson is modeling for students the task or skill they are expected to

**FIGURE 5**

**Strategies for addressing Myth 2.**

<table>
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<th>Language development strategies</th>
<th>Examples</th>
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<td>• Ill-structured, place-based learning opportunities allow students to interact in professional-amateur communities (Feinstein, Allen, and Jenkins 2013) while trying to solve a problem.</td>
<td>• As members of learning communities (professional-amateur), students practice, in the context of their projects, reading, writing, speaking, and listening skills.</td>
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<td>• Socio-scientific issues (SSI) act as platforms for the practice of language and inquiry skills.</td>
<td>• The SSI puts students in the context of an open-inquiry investigation where science and engineering practices are rehearsed (Figure 3).</td>
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<td>• Cross-curricular connections support conceptual learning.</td>
<td>• Students interact with different text formats and writing genres while gathering, interpreting, and illustrating the data. For instance, knowledge in the math, social studies, and language arts domains are practiced when students use a news piece from a popular magazine related to the SSI under investigation.</td>
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<td>• Usable and durable scientific knowledge has implications for future learning.</td>
<td>• Through citizen science or place-based learning projects, students learn to access information in the context of complex problems, become good consumers of scientific information who evaluate the evidence of scientific claims, and cultivate an appreciation for science while caring for the environment through civic engagement initiatives.</td>
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accomplish. When students are shown explicit examples of how to read, write, and argue in science, they are better prepared to start sharing, initially with their less-than-perfect English and their own understanding of scientific ideas. The level of precision in language usage evolves as students engage in learning opportunities that allow them to gradually develop language competencies in science.

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References
Center for Civic Education. 2014. Project Citizen. www.civiced.org/programs/project-citizen