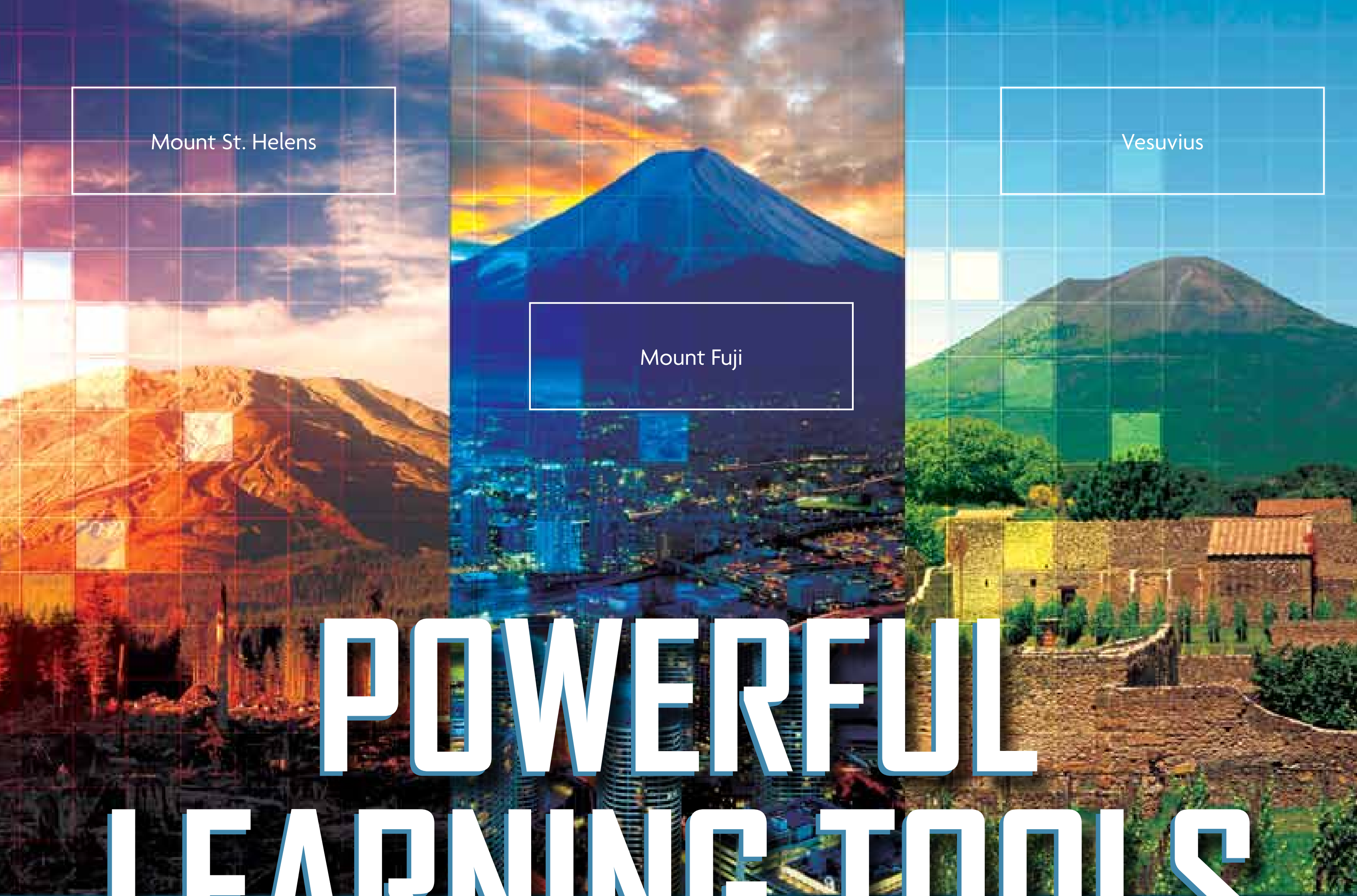


POWERFUL LEARNING TOOLS FOR ELLs

Using native language, familiar examples, and concept mapping to teach English language learners

Yu Ren Dong

English language learners (ELLs) struggle with science vocabulary every day. Unlike most native English speakers who have learned at least 12,000 words by high school (Nagy and Anderson 1984; Nation 2006), high school–age ELLs are just beginning their English learning. These students must learn everyday English, school English, and scientific vocabulary to pass examinations and meet graduation requirements.

On average, ELLs need five to seven years to catch up with their native English-speaking peers in grade-appropriate science learning (Collier 1987). My survey of New York City secondary science curricula shows that students need to learn close to 500 words in general science, over 1,200 words in biology, over 1,000 in Earth sciences, and additional words in chemistry and physics in order to pass the standardized tests and meet graduation requirements (Dong 2011, p. xv).

Vocabulary is the key to passing standardized tests, such as the Science Regents. In New York City, where I teach, one out of four public school students was an ELL in 2011 (New York City Department of Education 2011). Among ELLs, only 7% passed the Regents exams and graduated from high school on time in 2010 (Otterman 2011). By using ELLs' prior knowledge, science teachers can teach vocabulary in a meaningful and effective way and help more students to succeed in high school and, ultimately, in life.

Over the years, I have worked with both secondary preservice and inservice science teachers to develop effective vocabulary instruction for ELLs. In this article, I share three ways of using ELLs' prior knowledge to teach science vocabulary: tapping into ELLs' native language, designing culturally familiar examples, and using concept mapping.

The importance of prior knowledge

Adolescent ELLs aren't a blank slate when they enter the science classroom (August et al. 2005; Dong 2009; Dong 2011; Meyer 2000); many have had grade-equivalent schooling, acquiring native language literacy skills in their home countries. In fact, ELLs' prior learning lays an important foundation for their learning of English and scientific knowledge (Cummins 1979). Activating students' prior knowledge (i.e., the knowledge and skills a learner brings to a learning task) is a well-researched and field-tested vocabulary teaching strategy (Ausubel 1968; Rupley and Slough 2010).

ELLs who have scientific knowledge and literacy skills in their native languages can often translate these skills into English (Figure 1; Freeman and Freeman 2000; Townsend et al. 2012). For example, a student who has already learned about photosynthesis in his or her native language can transfer that prior knowledge into English to learn the vocabulary. Even ELLs who had limited or interrupted schooling can tap into their life and cultural experiences as a powerful science vocabulary-learning tool (Bruna et al. 2007).

When teaching science to ELLs, the concept of prior knowledge needs to encompass their

- native language,
- previous science learning,
- native literacy skills, and
- native cultural knowledge and life experiences.

Uncovering prior knowledge.

Science teachers can use various ways to learn English language learners' (ELLs') prior knowledge:

- Survey students.
- Ask English for Speakers of Other Language (ESOL) or bilingual teachers about ELLs' English proficiency levels and needs, their native language, literacy, and cultural background.
- Seek guidance from ESOL or bilingual teachers on how to teach challenging science reading materials and vocabulary in a comprehensible and meaningful manner.
- Invite students to talk and write about what they know about the topic before the lesson (e.g., "What do you know about...?" "What comes to mind when you think of...?" "How do you translate... in your native language?")

Tapping into ELLs' native language

ELLs can often learn science vocabulary through their native languages (August et al. 2005; Dong 2011; Rodriguez 2001); cognates (i.e., words that share a similar spelling, sound, and meaning across languages) can be especially helpful. For example, the English word *nucleus* is *núcleo* in Spanish and Portuguese and *noyau* in French. But science teachers don't have to be multilingual to use cognates or students' native languages. Online resources, such as Google Translate (see "On the web") can provide quick translations. Teachers can also ask ESOL (English for Speakers of Other Languages), bilingual, or foreign language teachers or even bilingual students to translate key words. Figure 2 (p. 54) provides an example of a multilingual visual glossary that a preservice biology teacher prepared for a pollination lesson with a class of ninth-grade ELLs.

Including students' native languages provides them with more means to learn science vocabulary and can help motivate them. Visuals (e.g., pictures, photos, concept maps, models) in combination with a multilingual glossary can enhance comprehension and create a rich context for concept learning, leading to increased confidence and engagement.

Designing culturally familiar examples

Science concepts are understood, expressed, and discussed using science vocabulary (Bialystok 2008). However, to achieve that concept understanding, science teachers must relate new concepts to ELLs' prior knowledge and remember that ELLs may have different background knowledge than native English-speaking students.

Ms. Lee, an Earth science preservice teacher, learned that her ELL students were confused with a textbook reading that used predominantly American examples (e.g., Mount St. Helens in a lesson about volcanoes). So, in planning her lesson on the topic, she gathered examples of volcanoes from each of her student's countries. ELLs were eager to use their prior knowledge to learn the new concepts.

Before teaching the concept of an animal cell, Mr. Robert, a high school biology teacher, talked to an ESOL teacher and learned that many of the school's ELLs came from agricultural and rural backgrounds. Realizing that these students may not understand the prototypical analogies for a cell (e.g., a city, factory), he adjusted his teaching examples—scaffolding students to generate their own culturally familiar analogies (e.g., a farm, a village) so they could gain meaningful understandings of the concept.

Using concept mapping

Concept mapping integrates students' prior knowledge and new knowledge (Novak and Gorwin 1984), moving vocabulary learning from isolated and individual word memorization to organized and coherent learning focused on relationships among concepts. In addition, teachers can gain insights into students' existing understanding, identify missing links in understanding, and tailor instruction to students' needs. Science teachers can prepare visuals themselves, assign students to create their own graphics, or borrow from online sources.

Ms. Jean, a biology preservice teacher, tutored three Ecuadorian middle school ELLs to help them learn about

FIGURE 1

Previous science learning survey.

Your home country:__________

Your native language:__________

When did you begin learning science in your native country? __________

What subjects have you learned in your native country?

❑ biology ❑ chemistry ❑ physics ❑ Earth science ❑space science ❑general sciences

❑ other (please specify) __________

What do you like most about science? Why?

____

Have you ever worked in a science lab in your home country? If so, what was it like and what did you do in the lab?

____

I learn science by (check all apply)

❑ repetition	❑ demonstration by the teacher	❑ memorization
❑ reading the textbook	❑ doing labs	❑ field trips
❑ writing	❑ talking to my classmates	❑ using visual pictures
❑ using maps and graphics	❑ learning vocabulary	❑ reading science articles
❑ listening to stories	❑ listening to the teacher's lectures	❑ taking tests
❑ doing experiments	❑ other (Please explain.)	

Who influences your science learning?

❑ my teacher	❑ my parent	❑ my siblings
❑ myself	❑ famous scientists	
❑ other (Please explain.)		

What is most difficult for you about learning science?

____

FIGURE 2

Multilingual visual pollination glossary.

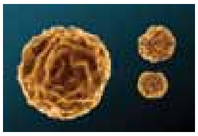
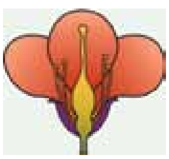
English	Picture	Spanish	French	Portuguese	Chinese	Korean	Urdu
Pollen: sticky powder produced by stamen		polen	pollen	pólen	花粉	화분	جرگ
Stamen: the male part of the flower that makes pollen; it includes anther and filament		estambre	étamine	estame	蕊	수술	زردار حصہ
Anther: the top part of the stamen that has pollen		antera	anthère	antera	花药	꽃밥	زیرہ
Filament: the long male stalk that carries the anther		filamento	filament	filamento	花长丝	필라멘트	تنت
Pistil: the female part of the flower that leads to eggs; it includes stigma and ovary		pistilo	pistil	pistilo	雌蕊	암술	بقچۂ گل
Stigma: the top of pistil is sticky to receive pollen		estigma	stigmate	estigma	柱头	오명	کلنک
Ovary: the base of the pistil where seeds are made		ovario	ovaire	ovário	卵巢	난소	انڈاشی
Pollination: the transfer process of pollen from an anther to a stigma		polin- ización	pollinisa- tion	poliniza- ção	授粉	수분	جرگن

FIGURE 3

An Ecuadorean student's cross-cultural biome comparisons.

Geographic location	My country: Ecuador (rain forest region)	New York
Types of biome	Tropical rain forest	Temperate forest
Weather	It is hot and humid year-round, and it rains a lot. About 450 cm of rainfall per year.	It is warm in summer but cold in winter. About 125 cm of rain and snow in a year.
Temperature	24°C annual average	13°C annual average
Plants	Plantain trees, palm trees, mango trees, orange trees	Shrubs, deciduous trees (e.g., maple trees, walnut trees, birch trees, dogwoods, willow trees, fir trees)
Animals	Vultures, crabs, cats, mice, snakes, monkeys, mosquitoes, fish, shrimp, dogs, dragonflies, horses, cows	Deer, owls, squirrels, bears, rabbits, skunks, raccoons, hummingbirds, eagles

Biome: The total amount of living things in a region, such as a rain forest.	
Comparing the two biomes	Both temperate forests and tropical rain forest have wet and hot days. They both have a lot of plants, animals, and food chains. But here in New York City, we have more cold and dry days. I'm not used to it yet. I still like to live in a rain forest where I can eat all sorts of tropical fruits and climb palm trees.

biomes. Ms. Jean first used New York as a sample biome but after consulting with her school's ESOL teacher realized the New York area might be unfamiliar to her students. She adjusted her lesson, asking students to talk about the weather, temperature, plants, and animals in Ecuador and then compare these with New York (Figure 3).

After uncovering students' prior knowledge, Ms. Jean assigned them to design a biome concept map of either Ecuador or New York. She asked students to first place their biomes in the centers of circles and then draw to show different categories: plants, animals, geography, and climate. Students used the internet to search for more information about their chosen biomes and organized their concept maps with the new vocabulary words (Figure 4, p. 56). Ms. Jean then designed a rubric to assess students' learning (Figure 5, p. 57).

The rubric revealed that students used both new and previously learned concepts to organize their maps. They progressed from simply listing concepts to building relationships among the concepts and discussing the biome's conditions. During their online search and concept mapping, Ms. Jean asked her students to write down any questions they had. She gave students a few sentence starters to provide language support, such as "I wonder…" and "Why is it that…?" Students asked questions such as

- "Why are there no palm trees in New York?"
- "Why don't we have snow in my hometown, Manta, back in Ecuador?"
- "I learned that there are highlands in Ecuador beside coastal cities. I wonder if those highlands in Ecuador also have the same hot and humid weather like my hometown."

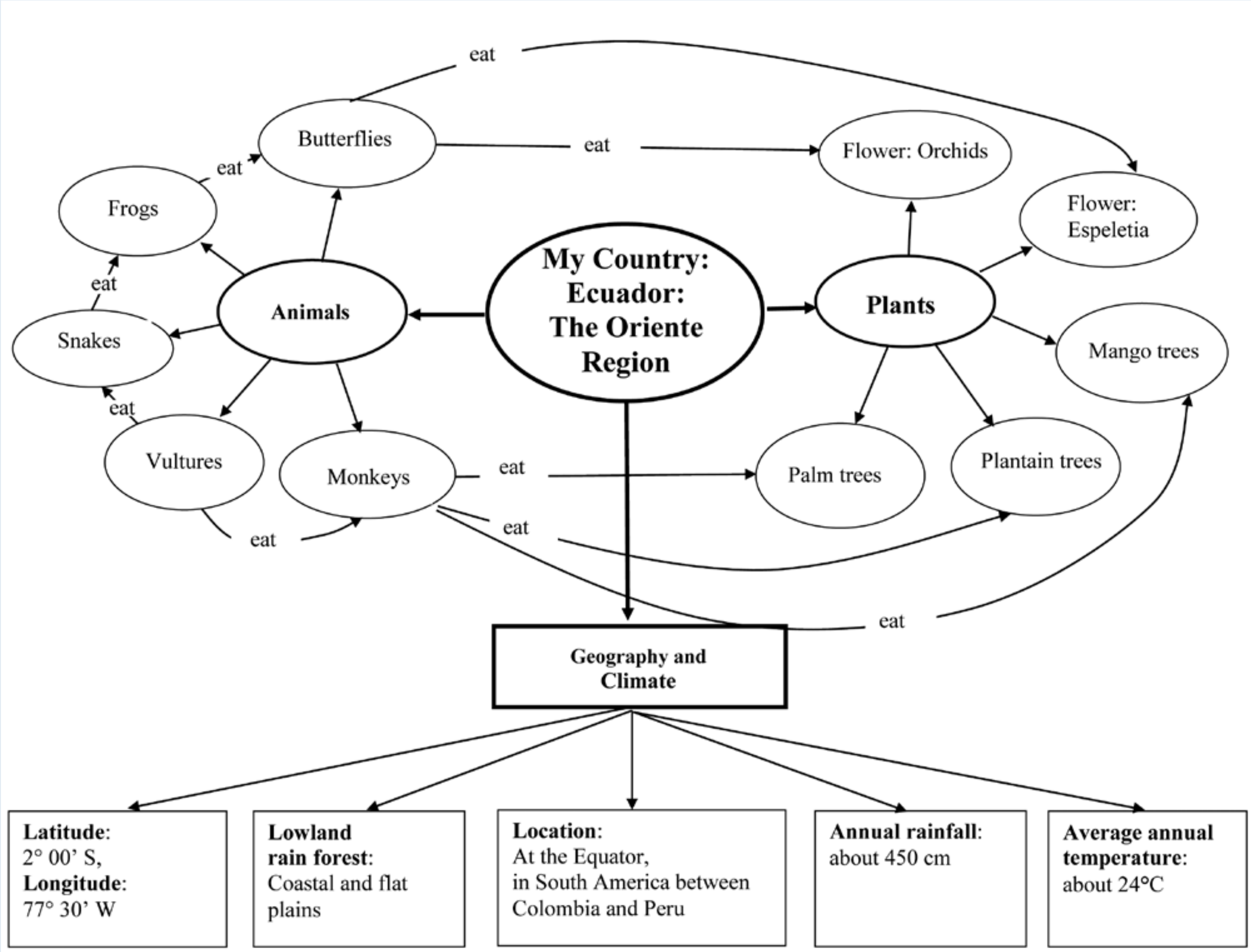
Using students' questions and concept maps as a point of departure for learning, Ms. Jean engaged them in thinking and talking about conditions required to make a biome tropical rain forest and geographical and climatic factors that impact plant and animal diversity and survival within a biome. This guided inquiry enabled students to analyze and synthesize using vocabulary learned to achieve a deeper understanding of the concepts (Dong 2011, p. 15).

Conclusion

When supported by their teacher, ELLs can understand challenging scientific concepts and participate in enriching cultural and science learning experiences. However, science teachers must also be aware of misconceptions and possible mismatches in cultural perceptions and expectations (Edmonds 2009).

FIGURE 4

Biome Concept Map



ELLs come into science class with prior learning, native languages, and cultural and life experiences. Despite the fact that their prior knowledge is acquired and expressed in their native language and may be different from what the science teacher expects, it is a powerful learning tool. By building upon ELLs' native language and bridging their prior knowledge with new learning tasks, science teachers can actively engage students and create a rich learning context, speeding up the learning process and increasing science understanding. ■

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On the web

Google Translate: *http://translate.google.com*

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FIGURE 5

Biome concept map rubric.

	Poor (1 pt)	Satisfactory (2 pts)	Good (3 pts)	Excellent (4 pts)
Knowledge	Shows little knowledge of biome concepts with minimal examples and notations.	Shows some knowledge of biome concepts with gaps in knowledge and insufficient examples and notations.	Shows a solid knowledge of biome concepts with minor gaps in knowledge, examples, and notations.	Shows excellent knowledge of biome concepts and sufficient examples and notations.
Organization	Serious errors in organization and difficult to follow.	Some lapses and mistakes in organization that affect understanding.	Has a few lapses in organization, but overall the concept map is easy to read and understand.	Well organized and concept links are easy to follow, coherent, and correct.
Concept connections	Concepts are randomly listed with minimal connections between them.	Concepts aren't presented as a web; some connections are incorrect or missing.	Concepts are presented as a web and linked correctly most of the time, but minor mistakes exist.	Concepts are linked in a web form, showing logical, clear, and coherent relationships.
Language	Major errors in vocabulary use, notations, and spelling.	Some errors in vocabulary use, notations, and spelling.	Appropriate use of vocabulary, notations, and spelling with only minor errors.	Appropriate use of vocabulary and notations with correct spelling.
				__/16

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