English Language Learners in the Science Classroom

by Felicia Lincoln and Caroline Beller

The changing demographics within our nation's public schools present teachers with new challenges. According to the 2000 census, the state of Arkansas, for instance, experienced a 300 percent growth in its minority language populations since 1990. That means that educators in regions such as this, and across the nation, are faced with the dilemma of meeting the needs of and providing positive educational experiences for students whose first language is not English.

Science education and English as a Second Language (ESL) have come under close scrutiny in the last few years, in part because of the pressure to improve students' scores in science on high-stakes tests. But the reality is that teachers must educate an increasing number of children whose languages, backgrounds, and educational needs are unfamiliar to them. What can we as teachers do to help English Language Learners (ELLs) learn science when we do not speak their languages or know their cultures?

A primary concern among teachers is that they will dilute content for special populations of students. But by writing goals and objectives for the entire class, teachers are able to meet the needs of language learners without compromising content. The only adaptations that should be made are those that allow students better access to the information and ultimately to the attainment of the goals and objectives. Both pre- and in-service teachers have successfully used the following strategies in teaching language and cultural minorities. These strategies can be, and often are, used by ESL teachers in pull-out programs.

1. Set goals before adapting the curriculum

Stimulate higher-order thinking by picking topics and objectives that challenge students. Then adapt the tasks, *not the content*, to better suit the needs of language learners.

The goal for a middle level class, for instance, may be

Felicia Lincoln *is an assistant professor of curriculum and instruction at the University of Arkansas in Fayetteville.* ***Caroline Beller*** *is a science educator in the school of teaching and curriculum leadership in the college of education at Oklahoma State University in Stillwater.*

to understand how sound travels. Students can work in groups to create a demonstration and each group member can then demonstrate one part of the presentation. Group work allows language learners to participate and see all parts of the demonstration without having to carry the weight of the entire project. An alternative to having language learners participate in the presentations is having them create the accompanying artwork or graphs. This way they can contribute to the group without having to stand up in front of the class.

As with all types of group work, it is important to monitor groups to ensure that all members are contributing. The methods you use in collaborative assignments will prove useful in the monitoring process. For instance, each member of the group may have a role to play. At the beginning of each group meeting, one student may be assigned the task of summarizing the previous day's work for the rest of the group, another student may be the illustrator, and still another may present information to the whole class. These responsibilities allow members to contribute in specific ways. It may also be helpful to offer extra credit points for presenting final results to the class in a second language. This provides an added incentive for language learners to stay involved and on task.

2. List and repeat lesson objectives and instructions

Repeat objectives to remind students of the purpose and focus of the lesson. Write the objectives on the board or on large posters and leave them where they can be clearly seen by students. It may also be helpful to have students create their own tip sheet or smaller poster with the lesson objectives and how those objectives relate to the task their group has been assigned.

As students work in groups, simply remind them of the purpose of the lesson: "Remember, we are talking about how sound travels." Or pose the question: "Now, what is the purpose of this activity?" As part of answering this question, English-speaking students paraphrase the learning objectives. In doing so, they often simplify language in a way that makes the objectives more accessible to language learners.

Later on, call attention to the poster or the tip sheet with the activity objectives and instructions, and have students read and re-read the tip sheet to others in their groups. This process reminds all students of the purpose of the assignment, and provides repetition for the language learners that is critically needed for comprehension.

3. Use simple language, not simple concepts

To better serve students, assess language learners' English ability as well as their content knowledge of science and specific science topics before beginning a thematic unit. The more you know about their abilities, the better. Fellow teachers, counselors, parents, and ESL faculty are good resources for gathering information on language learners' educational experiences. Ideally, a bilingual aide or faculty member should assess the student's exposure to the content in the student's first language. This has the advantages of being quicker and more accurate than assessments that measure only language ability.

If bilingual assessments are not possible, second language assessments should be done in as simple English as possible and should allow students more than one modality (speaking, listening, reading, and/or writing) for responding. A simple activity assessment for a unit on volcanoes may ask students, "What do you Know about volcanoes? What do you Want to know about volcanoes?" This leads to the follow-up assessment of "What did you Learn?" "KWL" assessments can be done orally or with graphic responses (drawing a volcano, labeling its parts, and/or writing about a volcano). However, it is probably best to start with an oral assessment until an understanding is reached about a student's literacy skills in English.

Another method of evaluating a student's content knowledge is asking inferential questions. It is important to allow for alternative assessments such as drawing, reporting orally, and writing. When concluding a thematic unit, encourage students to record their firsthand experiences and findings in languages other than English on video or audiotape. Consider keeping copies (with students' permission) for future reference as part of a multimedia classroom library.

4. Respond to the message

During class discussions and group presentations, it may be counterproductive to interrupt to correct for grammar or pronunciation. While it is important to model correct forms of speaking, the class objectives may best be met by tending to the science content only. At times it may be tempting to be both English teacher and culture expert while addressing science, but the language learner may lose focus or become overwhelmed with too much information about the mechanics of language.

This is also true for written work, as too many spelling and grammatical corrections may discourage or overwhelm students. One possibility is to select a grammatical form that is particularly problematic or distracting and make only those corrections. Or focus on making corrections that mirror the lessons currently being taught in ESL classes.

5. Demonstrate science concepts

One of the great aspects of teaching science to English language learners is that they too benefit from "best practice" approaches such as inquiry-based projects that use

FIGURE 1 **Checklist for cultural and language differentiation (Beller and Lincoln 2003)**

For assignment	For inclusion	Date
Pre-activity schema (something relevant to the cultures represented)	KWL: What do we Know? What do we Want to know? What did we Learn?	
Graphic organizers	Charts and graphs in the assignment	
Visuals	Pictures, videos, website information	
Enhanced vocabulary list	Modified vocabulary or glossary of terms in students' native language	
Group/pair/solo work	Several types of pairings per thematic unit to provide different types of scaffolding	
Cultural adaptations	Ways to involve non-native cultures and experiences in the unit	
First language accommodations	Opportunities to use non-native language to understand content	
Learning style accommodations (e.g., kinesthetic)	A variety of hands-on activities	
Comprehension checks	Tasks in which to paraphrase instructions	
Arts/crafts/drama	Role-play the discoveries made by famous scientists	
Problem-solving tasks	Scenarios that ask the students to solve a particular problem related to the unit theme	
Parental involvement	Opportunities for parents: field trips, parent conferences, group work facilitators	

graphs, charts, and brainstorming techniques. Teachers who use various media types, such as film, video, audio, and computer software, will find that language learners also respond positively to those forms of instruction. Classroom teaching for diverse students is most effective when it incorporates all senses, all intelligences, and all learning styles.

Graphic organizers of all kinds are especially helpful when trying to appeal to different ways of learning. For example, for a unit on tornadoes, have students complete a handout that outlines the conditions for tornado formation. To reduce the language learning burden of listening to class lectures and discussions, fill in every third or fourth space in the organizer beforehand, while leaving the handouts for the rest of class completely blank. No one need know that not all handouts are alike. To appeal to other learning modalities, invite students to write a song that describes tornadoes or parts of a volcano that can then be performed for the class. Students may find it interesting to play the roles of scientists who made great discoveries while they are making the same discoveries.

6. Provide additional vocabulary help

Simplify language and paraphrase when possible, and provide linguistically simpler tasks. A simple way to do this is to ask native English speakers or other language learners to re-state the instructions or explain complex ideas. Students often present information using simpler vocabulary, making the information more accessible to language learners. It may be useful to assess language learners verbally or graphically by allowing them to demonstrate content knowledge with pictures or graphics rather than with text.

7. Increase wait time

Processing language can be slow, especially at first. Some students may be translating from English to their first language and then translating their responses to English again. When asking questions, allow students extra time to formulate responses. In general, it is best not to force reticent students to speak. Instead, allow them to write in their journals about the science unit. Or, if presenting is a necessary part of a project, discuss the student's piece of the presentation with the student in advance.

It may help for the teacher or a responsible student to carefully prepare the language learner for the presentation. As the school year progresses, gently encourage language learners to join in group discussions.

8. Encourage student collaborations

Pair native with non-native speakers, taking into consideration personalities and learning differences and styles. Students who enjoy working collaboratively or helping other students by tutoring often make great partners. Teachers should make (and usually have) mental notes of students who are eager to help or who work well with others. Encourage language learners to read, write, and share thoughts with aides, parents, or other students from their cultures and languages of origin in their first or second language. Using their first or home language to discuss content offers students opportunities to manipulate abstract or complex content in ways they struggle with in a second language.

9. Include language minority parents

In classrooms emphasizing inquiry-based learning, it may be useful to group language learners who speak the same first language together and invite parents to come to class to act as facilitators. As mentioned above, information learned and manipulated in the first language affords students opportunities to think and discuss abstract concepts that they might not easily do in a second language. This content knowledge then transfers to the second language.

Final thoughts

With more and more emphasis on the inclusion of all students into the mainstream, content teachers are faced with the challenge of educating children at different learning, reading, and writing levels. In addition, teachers are often finding themselves faced with educating children who may be able to work at grade level in their own language, but are unable to understand much of what is going on in an English-speaking classroom. Figure 1 is a checklist for adapting classroom instruction to better address the needs of language learners.

While this list was created with language learners in mind, many of the suggestions are helpful for English-speaking students with other types of learning differences. This is not a definitive list, however, and should be modified to best suit the needs of your students. ■

Resources

Beller, C., and F. Lincoln. 2003. Including English Language Learners in the science classroom. Paper presented at NSTA National Conference in Philadelphia.

Claire, E., and J. Haynes. 1994. *Classroom Teacher's ESL Survival Kit #1*. White Plains, N.Y.: Pearson Longman.

Feyten, C., et al. 2002. *Teaching ESL/EFL with the Internet: Catching the Wave*. Upper Saddle River, N.J.: Merrill Prentice Hall.

Freeman, D., and Y. Freeman. 1994. *Between Worlds: Access to Second Language Acquisition*. Portsmouth, N.H.: Heinemann.

Gaskell, J. 2003. Engaging science education within diverse cultures. *Curriculum Inquiry*. 33(3): 215–235.

Kendall, F. (ed.) 1996. *Diversity in the Classroom: New Approaches to the Education of Young Children* (Early Childhood Education Series). New York: Teachers College Press.

Lincoln, F. 2003. Language education planning and policy in Middle America: Students' voices. In Hornberger, N. (ed.) *Continua of biliteracy: An ecological framework for educational policy, research, and practice in multilingual settings*. Clevedon, England: Multilingual Matters, Ltd.

Meyers, M. 1993. *Teaching to Diversity: Teaching and Learning in the Multi-ethnic Classroom*. San Diego, Calif.: Addison-Wesley.

Rice, C. 2001. Welcoming ESL learners into the mainstream classes: An experience of classroom research and publication. *TESL Reporter* 34(1), 12–21.

Smith, D. 2002. *If the World Were a Village*. Tonowanda, N.Y.: Kids Can Press.

Thomas, W., and C. Collier. 1997. *School Effectiveness for Language Minority Students*. Washington, D.C.: NCBE.

Watson, S.M.R., and L.E. Houtz. 2002. Meeting the needs of culturally and linguistically diverse students. *Intervention in school and clinic*. 37(5), 267–278.

Internet resources

• Artsedge—*artsedge.kennedy-center.org*
Includes complete lesson plans in science.

• BBC World Service—*www.bbc.co.uk/worldservice/learningenglish/index.html*
Offers teaching programs in more than 30 languages. Extra features include weekly explanation of words in the news and a discussion group and audio extracts.

• CAL—*www.cal.org/topics/index2.html*
CAL is a private, non-profit organization that uses the findings of linguistics and related sciences in identifying and addressing language-related problems.

• CNN—*www.cnn.com*
Offers current reading materials, news stories, and interactive news quizzes.

• Dave's ESL Cafe—*www.eslcafe.com*
This is simply the best and includes some of everything.

• Online Dictionary—*dictionary.reference.com*
Provides quick answers and correct pronunciation.

• Discovery Channel—*dsc.discovery.com*
The ESL Area—*members.aol.com/adrmoser/science.html*

• ESL Independent Study Lab—*www.lclark.edu/~krauss/toppicks/toppicks.html*
Includes links to sites for listening, reading, writing, grammar, vocabulary, pronunciation, TOEFL, content/research, and fun and games. Fully annotated and graded by language ability.

•ESL Technology—*www.lclark.edu/~krauss/tesol98/webresources.html*
Provides resources for integrating technology into a curriculum.