ERIC® CLEARINGHOUSE ON LANGUAGES AND LINGUISTICS
CENTER FOR APPLIED LINGUISTICS

0436-1

ERIC/CLL NEWS BULLETIN

VOLUME 21, NO. 2 SPRING/SUMMER 1998

Developing the Language of Mathematics in Partial Immersion: The Ladder to Success

Regla Armengol, Spanish Immersion Teacher
Bailey's Elementary School for the Arts and Sciences, Fairfax County Public Schools, VA

Ingrid C. Badía, Spanish Immersion Teacher
Lake Anne Elementary School, Fairfax County Public Schools, VA

Kendra stands proudly in front of the class calendar. She has successfully answered a problem-solving question: *What is the date of the last Tuesday in October?* But, now comes the hard part: *Kendra, how did you solve the problem?* Her eyes dart from the teacher's face to the calendar. Obviously, the wheels are turning as she works to understand her thinking processes. She is putting the pieces together, and it takes time and concentration. Then, she explains: *I know that October has 31 days, so the last Tuesday must be here. I started at 31 and counted backwards.* (Note: This classroom exchange took place in Spanish.)

Kendra is 7 years old. This is only her second year in our Spanish partial immersion program, and already she has succeeded in doing what truly makes a person bilingual: She can think in the target language, and she can explain her thinking to herself and others. This type of language development does not happen overnight, nor can it be found when teaching is haphazard. It results from the implementation of cohesive teaching strategies and a daily process of hard work.

Helping students to develop mathematics problem-solving skills is an important challenge for those of us who teach a foreign language through academic content. It requires the simultaneous development of cognitive academic language and higher order thinking skills. Yet, problem solving is the crux of mathematics education today. If we are to meet our goals of teaching both content and language, we must address the problem-solving challenge.

Our classroom research and experience demonstrate that we can make significant progress toward meeting these goals by integrating language and problem solving in a systematic step-by-step approach. As each step builds on previous ones, students reach higher levels of achievement simultaneously in both language and problem solving, thus "climbing a ladder" toward mastery of these instructional objectives (see Figure 1).

The teacher builds the ladder with appropriate language and problem-solving activities, achieving synergy between the two. The teacher also ensures that higher rungs of the ladder incorporate increasingly complex language and problem-solving activities. As students climb the ladder, they achieve proficiency in both the target language and problem-solving skills.

Establishing the Foundation

To build the ladder, the teacher must provide students with the necessary language foundation to understand mathematics word problems and use the target language as a vehicle for meaningful daily communication in the classroom. To help in this process, the teacher models the written language used in solving word problems, then provides students with many opportunities for guided practice with word problems.

Building this language and problem-solving ladder also requires students to learn a step-by-step format to solve mathematical problems. Not only do students need to understand the language of the problem, but the problem-solving strategies as well. As students climb the ladder, they need to be able to verbalize the steps they used to solve the mathematical problems.

Teaching activities used while the students' achievement is at or near the bottom of the ladder focus on established classroom routines. An example of such an activity is calendar talk, which introduces the language of mathematics problem solving and metacognition. This activity uses phrases of language, repetition, and explicit instruction of language forms to build a secure foundation for communication.

CONTINUES ON PAGE 4

0436-2

Mathematics in Partial Immersion

CONTINUED FROM PAGE 1

Figure 1. Building the Ladder

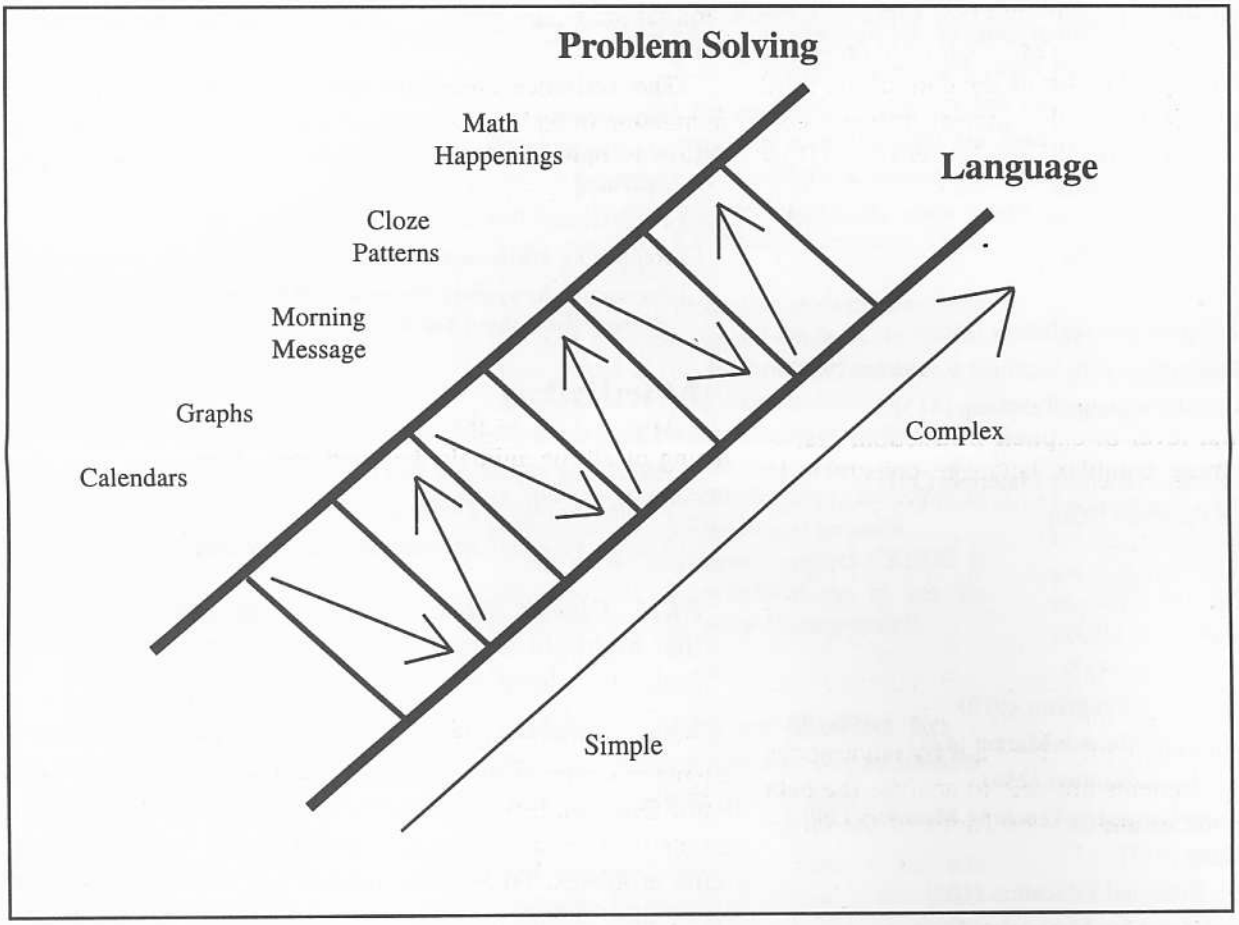


Figure 2. Calendar Activity

El Calendario

lunes	martes	miércoles	jueves	viernes	sábado	domingo
					1	2
3	4	5	6	7	8	

0-436-3

Using Calendar and Graphing Activities

Using a calendar of the current month (see Figure 2), the teacher asks calendar questions, such as *¿Cuál es la fecha del tercer miércoles de diciembre?* (What is the date of the third Wednesday in December?) When the student answers correctly, the teacher asks *¿Cómo resolviste el problema?* (How did you solve the problem?) If the student answers in English, the teacher models the answer in the target language and writes the phrase on a sentence strip that goes on the board. On subsequent days, other solutions are modeled and added to the collection of sentences on the board. Before long, a repertoire of target language sentences is readily available for the students to express their solution strategies.

Building on the first level of explicit instruction, graphing activities require more complex language constructs to describe comparisons and analyses. After a class graph has been completed, the teacher leads the class through a group lesson in which she asks *¿Qué nos dice esta gráfica?* (What does the graph tell us?) Students respond either in English or in the target language. The teacher records their responses on chart paper, thus modeling the written target language: for example, *Hay 22 alumnos en total. Hay 5 niños más que niñas.* (There are 22 students in all. There are five more boys than girls.) Before long, students are able to analyze the data independently in both verbal and written forms of the target language.

Incorporating Mathematics into the Morning Message

Another activity that integrates the target language with mathematics problem-solving skills is a morning message. A morning message can be used to teach a variety of written structures, and it provides a natural opportunity for teachers to guide their students toward understanding more complex language structures and mathematical concepts. This message is part of a daily routine in which the language is modeled in written and verbal forms for the entire class. Math word problems that relate to classroom experience become part of our morning message. For example, during our science unit on crickets, we used this word problem: *Había siete grillos en la jaula. Dos se escaparon. ¿Cuántos quedan?* (There were seven crickets in the cage. Two escaped. How many are left?)

The morning message activity provides students with multiple opportunities to practice the language in conjunction with mathematical problem-solving skills. At every opportunity, the teacher asks *¿Cómo resolviste el problema?* (How did you solve the problem?) The students thus establish a connection between the language learned and the mathematical problem being addressed. To assist in this process, the teacher provides the students with language support through the use of familiar language phrases that relate to the current unit of study.

The activities described above are intended to build a foundation in both verbal and written language. Once the foundation is built, students are ready to increase their writing activities in the target language and to solve their own word problems.

Using Cloze Patterns

Cloze pattern word problems allow students to practice the writing of word problems. The following example shows how a cloze pattern can be used in the classroom.

After a visit to the zoo, the students generated a visual listing of all the animals they had seen. Then as a class, they practiced writing a word problem, such as the exercise in Figure 3. Students filled in the cloze pattern using the visual list and then solved the word problem together. Each student was then given the opportunity to write a word problem using the cloze pattern and to solve it with a partner. As part of the concluding activities, students took turns reading their word problems to the class and having the group solve them.

Cloze pattern word problems provide strong exposure to language structure while relating the language to math problems. Once students are familiar with these highly structured problems, they are ready to experience and solve less structured problems. To prepare students for less structured problems, the teacher can expand students' mathematical problem-solving skills by teaching them a plan to solve word problems as well as to use solution strategies.

Figure 3. Cloze Exercise

En el parque zoológico yo vi _____ _____
(número) (animal)

y _____ _____
(número) (animal)

¿Cuántos animales vi en total?

(At the zoo I saw _____ _____
(number) (animal)

and _____ _____
(number) (animal)

How many animals did I see in all?)

CONTINUES ON PAGE 6

Solving Word Problems

The first step in solving a math word problem requires that students understand the question of the problem. In a partial immersion classroom, it is important that the word problems presented to the students contain familiar language. Using familiar language makes it easier to understand what is happening in the word problem and to identify the key information needed to solve the problem.

Students must be able to explain the problem in their own words as well as restate the question they need to answer. The word problem should first be discussed as a class. Then the students may be paired and asked to take turns reading the problem and explaining it in their own words before trying to solve it.

After students demonstrate their understanding of the question, they need to learn tools that they can use to solve the problem. These tools are in the form of solution strategies, which the students will learn to recognize and use appropriately. Solution strategies may include creating a table, drawing a picture, looking for a pattern, using logical reasoning, using manipulatives, making a list, and working backwards. These solution strategies are explicitly taught to the students. The teacher focuses on one solution strategy at a time and models how and when to use that strategy. After the students have had many opportunities to practice all the solution strategies, they will have important tools to help them choose the appropriate solution strategy to solve word problems.

Using the Language of Metacognition

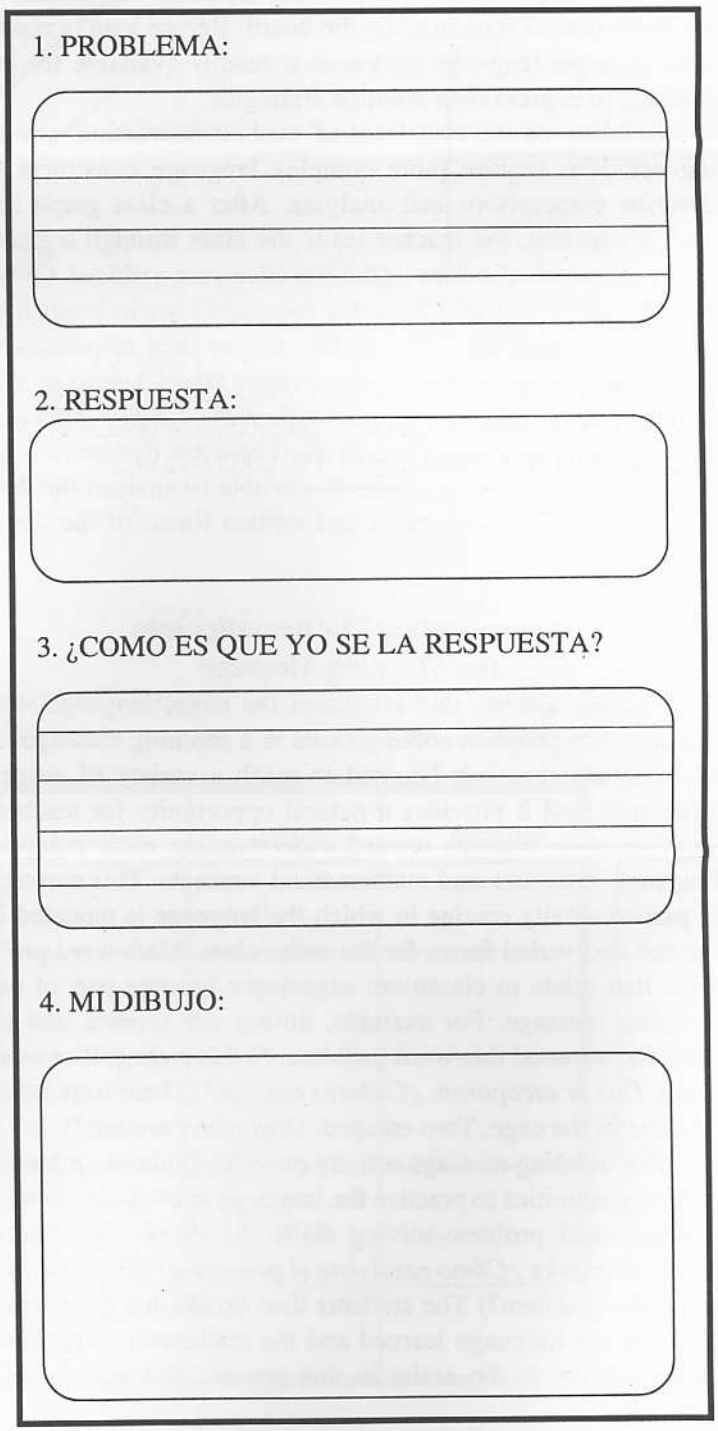
Students must not only learn to choose solution strategies to solve word problems, they must also learn to record and verbalize how they used the strategies to solve their problem. It is important for students to become adept at the language of metacognition to express their thinking processes thoroughly in the target language. This skill is particularly emphasized in the partial immersion classroom. When students can demonstrate their thinking in the target language, they are near the top of the ladder.

A template to record students' thinking processes is shown in Figure 4. This template includes sections for writing the word problem, identifying the strategy used, depicting the work, writing the solution, and explaining the answer. When students use the template, they express the problem and solution in the target language, thus reinforcing the integration of language and content.

Finding Math Happenings in Everyday Life

To reach the top of the problem-solving and language ladder, students are encouraged to begin to create independently their own word problems in the target language. Students should move away from structured word problems and find examples of how "math happens" in everyday life. Students begin to be more creative and are prepared for more open-ended word problems. As they write their own word problems, students must include the necessary information to solve the problem, identify the most appropriate strategies, and explain their thinking processes.

Figure 4. Problem-Solving Template



Mathematics in Partial Immersion

FROM PREVIOUS PAGE

Conclusion

Fairfax County Public Schools (Virginia) chose mathematics as a vehicle for teaching and learning the target language because of its hands-on nature. What was discovered is that the development of higher-level math problem solving and sophisticated target language acquisition should occur simultaneously for children to progress up the ladder of learning for each subject. Neither of these aspects can be neglected. The successful teacher must draw in and integrate all threads of the curriculum to make the learning whole and real-life. A systematic and comprehensive approach results in the synergistic development of math problem-solving skills and second language acquisition. ■

This article is reprinted, with minor changes, from ***Learning Languages*** (Volume 3, Number 3, Spring 1998), the journal of the National Network for Early Language Learning (NNELL). ***Learning Languages*** is published three times a year. Membership dues for NNELL, which include a subscription to the journal by academic year are $20 per year ($25 overseas). Please send your check to Nancy Rhodes, Executive Secretary, NNELL, 1118 22nd Street NW, Washington, DC 20037-1214.

New ERIC/CLL Publication

Foreign Language Assessment in Grades K-8: An Annotated Bibliography of Assessment Instruments (1997) describes foreign language assessment instruments currently in use in elementary and middle schools aross the country and lists resources related to foreign language assessment. Available from Delta Systems Co., Inc., 1400 Miller Pkwy., McHenry, IL 60050; 800-323-8270 (toll free); 815-363-3582 (in Illinois).

Coming in Fall 1998

The American Bilingual Tradition

by Heinz Kloss

New Introduction by Reynaldo F. Macías and Terrence G. Wiley

Paperback. 496 pages. $22.95.
ISBN 1-887744-02-9

This reprint edition of *The American Bilingual Tradition* offers a valuable scholarly contribution to the current debate over bilingualism and language diversity in the United States. Written by an eminent European language historian, it challenges widespread myths about alleged differences between recent immigrants to the United States and those of past generations.

A new introduction by Reynaldo Macías and Terrence Wiley positions Kloss's work by highlighting his analysis of the history of language policy in the United States, which generally fostered tolerance and respect for minority language rights. *The American Bilingual Tradition* offers a refreshing perspective that will be valued by both serious students of the history of language policy and the general public.

Available from Delta Systems Co., Inc.,
1400 Miller Pkwy., McHenry, IL 60050
800-323-8270 (toll free); 815-363-3582 (in Illinois)