THE CALLA™ HANDBOOK

Implementing the Cognitive Academic Language Learning Approach

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Table 10.1
Language Skills Required in Mathematics

Language Skills	Grades 1-3	4-6	7-12
Listening			
1. Understand explanations without concrete referents.	L	P	M
2. Understand oral numbers.	M	M	M
3. Understand oral word problems.	M	P	L
Reading			
1. Understand specialized vocabulary	L	P	M
2. Understand explanations in the textbook.	L	P	M
3. Read mathematical explanations.	L	P	M
4. Understand word problems.	P	M	M
Speaking			
1. Answer questions.	M	M	M
2. Ask questions for clarification.	M	M	M
3. Explain problem-solving procedures.	M	M	M
4. Describe applications of math in other content areas	M	P	P
Writing			
1. Write verbal input numerically.	M	P	P
2. Write word problems.	P	P	L
3. Write words for number sentences.	M	P	L

less emphasis	partial emphasis	more emphasis
L	P	M

What's Difficult in Math For ESL Students?

- Language dependence in mathematics—Specialized terms and terms used in unique ways; syntactic features of word problems.
- Non-linguistic difficulties—Students must process complex concepts and different uses of otherwise familiar terms.
- Cultural differences—Cultural differences in the use of decimals and commas, in fractions, or in the strategies students use to solve word problems.
- Instructional implications—Special procedures are needed that enable students to test hypotheses about language use and other potential problem areas.

Teaching Guidelines for CALLA Mathematics

One of the major reasons for studying mathematics is to learn how to solve problems. Through the study of mathematics, students are prepared to solve problems they encounter in a natural way in the world around them as well as in the further study of mathematics and sciences. To become effective problem solvers, learners need to understand concepts, know basic facts, use computational skills efficiently, and select and apply appropriate problem-solving strategies.[24]

SELECTING PRIORITY CONTENT

The mathematics curriculum taught in schools today emphasizes breadth of coverage at the expense of depth and contains considerable overlap in content between grades.[25] In CALLA, we suggest that teachers identify high-priority content through discussions with content-area teachers, inspection of grade-appropriate texts, and analysis of math frameworks across the grades. Teachers should look for recurring themes or for specific areas on which ESL students can be expected to have the most serious difficulties and treat these areas in depth. In math, at least two areas stand out in this respect. The first is solving word problems, and the second is fractions. We have decided to concentrate on word problems in our detailed analysis of the CALLA approach in mathematics because of the general applicability of problem-solving procedures across various types of problems. Those interested in strategies for other topics in mathematics will find other resources available.[26]

In our discussion of mathematics instruction for ESL students, we assume the students have some knowledge of elementary mathematical concepts, basic facts, and fundamental computational skills in the four basic operations (addition, subtraction, multiplication, and division). This is simply because we focus on *language* and *problem-solving* skills exclusively and do not describe instructional procedures for introducing basic math skills. However, we do *not* necessarily assume that students will already have acquired accurate and automatic use of basic math facts by

Table 10.3
LEARNING STRATEGIES FOR MATHEMATICS

Metacognitive Strategies:	Students plan, monitor, and evaluate their learning of mathematics concepts and skills.
Advance Organization	What's my purpose for solving this problem? What is the question? What will I use the information for?
Selective Attention	What words or ideas cue the operation?
	Where are the data needed to solve the problem?
Organizational Planning	What plan will help solve the problem? Is it a multiple-step plan?
Self-monitoring	Does the plan seem to be working? Am I getting the answer?
Self-Assessment	Did I solve the problem/answer the question? How did I solve it? Is it a good solution? If not, what could I do differently?
Cognitive Strategies:	Students interact with the information to be learned, changing or organizing it either mentally or physically.
Elaborating Prior Knowledge	What do I already know about this topic or type of problem? What experiences have I had that are related to this? How does this information relate to other information?
Taking Notes	What's the best way to write down a plan to solve the problem? Table? Chart? List? Diagram?
Grouping	How can I classify this information? What is the same and what is different?
Making Inferences	Are there words I don't know that I must understand to solve the problem?
Using Images	What can I draw to help me understand and solve the problem? Can I make a mental picture or visualize this problem?
Social/Affective Strategies:	Students interact with others to assist learning, or use attitudes and feelings to help their learning.
Questioning for Clarification	What help do I need? Who can I ask? How should I ask?
Cooperating	How can I work with others to answer the question or solve the problem?
Self-talk	Yes, I can do this task—what strategies do I need?

APPLYING LEARNING STRATEGIES TO MATHEMATICS

Mathematics Problem-Solving Steps

Understand the Question

Find the Needed Information

Choose a Plan

Solve the Problem

Check the Answer

Table 10.4

Learning Strategies for Math Problem-Solving Steps

Problem-Solving Step	Learning Strategy
1. Understand the Problem	Elaboration
	Imagery
	Inferencing
	Summarizing
	Cooperation
2. Find the Needed Information	Selective Attention
3. Choose a Plan	Prediction
	Imagery
4. Solve the Problem	Cooperation
5. Check the Answer	Self-evaluation
	Cooperation

feedback on preliminary attempts to represent the problem. Students will be led to examine their own information and strategies based on group challenges, disbelief, or affirmation. A second major function of small groups is to supply background information that individual students may not possess. A strategy such as "select only the numbers that are needed to solve the problem" may have little meaning if the student does not possess enough information to identify the relevant numbers. Lack of adequate background information is one of the major obstacles to successful problem solution among native English-speaking students,[31] and should be an even more important obstacle to students from other cultures. A third major function served by small groups is that effective problem solvers who verbalize their own problem-solving processes are modeling the avenues to problem solution for less effective problem solvers. The students can profit from observing each other's thought processes as they are verbalized. These externalized verbalizations of problem solving processes are more likely to occur in small groups of three or four than in pairs.[32] A fourth significant benefit from working in small groups is that students who verbalize problem-solving steps and the strategies associated with them are more likely to transfer problem-solving procedures to subsequent problems. As a final benefit, students who work in small groups independent of the teacher's immediate control are taking responsibility for their own learning and rehearsing independent working skills. Basically, a student does not have to work alone to