
TESOL strategies for the mathematics classroom

SALLY ROBISON

Florida Atlantic University

Teaching mathematics becomes especially challenging when including the needs of the limited English proficient students who struggle with language and cultural issues. However, many strategies exist that can ease the difficulty involved in providing a quality mathematics experience. The strategies to help the limited English proficient student are separated into three specific categories: literacy development strategies, cultural harmony strategies, and effective instructional strategies. Each category has specific suggestions and real class examples that make teaching mathematics to ALL more than just a possibility.

There is a growing presence in Florida classrooms of Limited English Proficient (LEP) students who present math teachers with a pedagogical challenge. LEP students need many opportunities to learn all aspects and complexities of mathematics while obtaining academic and communicative competence in English.

ESOL (English for Speakers of Other Languages) is, by definition, the language arts component in the education of LEP students. However, the main goal of ESOL instruction is communicative competence. Since the goal of communicative competence is not limited to areas traditionally covered in a language arts curriculum, the extension of ESOL based instructional strategies to content areas such as mathematics, social studies, and science has not come as an educational surprise.

ESOL and content is an approach that integrates second language instruction with content area instruction. Lessons contain both content objectives and language objectives. Students learn language through specific subject matter rather than through isolated activities. (Short, 1989; Cantoni-Harvery, 1987). In other words, students do not have to

wait to learn English in order to continue learning in the specific content areas.

The New Learning Group, NLG, (1996) described *situated practice* as "immersion in meaningful practices within a community of learners [and experts] who are capable of playing multiple and different roles based on their backgrounds and experiences" (NLG, 1996, 85). Situated practice in an authentic learning environment with student valued tasks facilitates literacy development.

Overt instruction refers to "active interventions on the part of the teacher and other experts that scaffold learning activities . . . [to] allow the learner to gain explicit information . . . when it can most usefully organize and guide practice" (NLG, 1996, 86). In this environment, teachers ask thoughtful questions and provide mentoring and support to ESL students. Students, therefore, gain "conscious awareness of and control over what is being learned" (NLG, 1996, 86).

Critical framing encourages learners to evaluate what they have learned, to constructively critique that learning, and to creatively extend and apply it to new contexts (NLG, 1996, 87). This definition directly applies to the concept of problem solving in mathematics. Teachers can not provide, nor expect to provide, every possible scenario in mathematical problem solving, but should provide connections to strategies that assist the student in mathematical challenges. Encouraging students to make connections, reason mathematically, solve problems, communicate their thinking and represent their findings in a meaningful way to formulate the five process standards that encourage "mathematical confidence" as defined in the NCTM *Principles and Standards* document (NCTM, 2000).

In a study by Loretta Kasper, students perceived learning best transpired through "a content-based pedagogy like focus discipline research that fosters a learning environment within which students become partners and participants in meaningful interaction with peers and teachers to design learning contexts, examine interdisciplinary issues, and articulate knowledge." (Kasper, 2000,105). The study found that participants developed literacy skills in the academic, social and professional contexts beyond the ESL classroom. Although the study focused on college students, the implications for classroom teachers is apparent.

Many strategies exist for teachers to use in order to facilitate the learning and application of mathematical concepts by all students, including those who are language enriched. These strategies have been categorized into the following areas: Literacy Development, Cultural Harmony, and Effective Instruction/Assessment.

LITERACY DEVELOPMENT STRATEGIES

1. **REVIEW.** Be prepared to review concepts if needed. Review mathematical terms that may be abstract or confusing to students. For example, a lesson on multiplication of two digit numbers may require an explanation and review of product, sum, carry, exchange and equals in a contextual setting. A lesson on the division algorithm may require the teacher to cover the methods used in the United States that may or may not be similar to the students former knowledge of division.

2. **VOCABULARY BUILDING.** Introduce pertinent vocabulary in each lesson using realia and demonstrations whenever possible. Examine the textbook in advance to identify terms that will be new to the students. Be prepared to cover any symbols or words that may be new or that may create problems for the students. The new vocabulary should be repeated often in a meaningful setting and/or paraphrased in order for students to retain and use the concepts that are related. Use synonyms that are needed to insure understanding. Capps (1993) recommends a minimum of six exposures to a new word during the lesson and at least 30 additional exposures throughout the following month. Mathematics has often been referred to as a foreign language. It possesses its own vocabulary and meanings that hold double meanings outside the subject. Teachers need to clarify expressions, words and symbols that have multiple meanings. For example, the word “reciprocal” is similar to the word “reciprocate”, but does not imply the same meaning. The word rationalize has a meaning in normal context, yet a totally different meaning in the realm of mathematics. Remember that the repertoire of methods and activities, such as writing words and definitions, spelling tests, and providing pictures of words often used to teach vocabulary in other areas are just as appropriate when teaching a mathematics lesson.

3. **SYMBOLISM.** Abbreviations and symbols can create confusion. Capps and Gage (1987) call attention to the fact that abbreviations and other mathematical symbols create difficulties in a child's ability to understand. For example, teachers should avoid using traditional symbols without providing an interpretation, such as \sim for similar shapes or abbreviations such as pt. for pint or ft. for feet until the students have been clearly introduced to this new symbolism.

4. **SPEAK CLEARLY.** Use clear, basic English for questions and explanations. Give short, concise directions one step at a time and repeat them as needed. Adapt your lessons if complex explanations have been typically used. For example, expressions such as "one dog, two cats" may be confusing to the ESL student. They may not associate the word you use with number of items, but rather the type of item. If necessary, rewrite word problems and instructions into simple English. American vocabulary is quite fluent and filled with clichés and slang words that should be avoided. To ensure a smooth instructional setting, establish verbal routines for common computations.

5. **REALIA.** Teach vocabulary and performance tasks in relation to the student's own real world experiences. Use common foods, names and traditional holidays when making up problems. For instance, when teaching about fractions, relate to egg cartons or pies to illustrate the values of halves, fourths or quarters, thirds and sixths. Use real situations that work best for your instructional lesson, for instance, have them handle money in the school store, tell the time, use the calendar, and measure height and weight.

6. **MODEL IT.** Model the use of appropriate math vocabulary when interacting with students and encourage "them" to discuss and use the new concept and role of the word. For instance, subtraction is often called take away, minus, or difference. Teachers should work towards the mathematically correct terminology eventually by asking students to explain how they found the "difference" when discussing an example on subtraction.

7. **WRITE ABOUT IT.** Give students the opportunity to write about their new math concepts. Journals are an excellent way to determine the degree of understanding and provide students with the opportunity to express their concerns and issues without peer pressure inhibiting their interactions with the teacher. For instance, have them

rewrite a textbook sentence in their own words in order to help them clarify their own thinking. Encourage them to write their own definitions to words and have them draw pictures to create their own math dictionary. Students should create their own word problems to share with classmates. They will have a good time doing this and it is a useful tool for the students to develop their own interests and understanding.

8. **READ SLOWLY.** Interestingly enough, students need to be taught to read their math books slowly and carefully. They often skip past the words and look specifically at the diagrams and examples without utilizing the valuable dialogue included. Teachers can encourage students to use the textbook guides, such as boldfacing, underlining as well as the glossary in the back. However, when these tools fail, they should be encouraged to ask for an explanation of a word or sentence if they are having difficulty understanding. Encourage them to search for meanings to new mathematical terms by providing a mathematics dictionary as well as the typical dictionaries, but avoid routine assignments of looking up words and writing down definitions. These activities, as well as the excessive use of drill exercises, do little to excite or encourage mathematical development.

9. **PACING.** Teachers should recognize that students process quicker in their verbal skills than they do in their writing skills. This is the normal process of learning a second language. Encourage writing often, approximately 3 times a week, by providing prompts and an audience to write to. The teacher should model writing during instruction and class discussions. Above all, allow them to make both grammatical and pronunciation mistakes at times, however be sure to model the correct response.

10. **BOOKS.** Share your favorite selections of mathematical children's literature with them. So many excellent mathematical resources exist that promote and develop mathematical concepts. In fact, some books are specifically designed to teach mathematical concepts through the use of dialogue and pictures. For instance, using the book, *Patchwork Quilt* (author needed), discusses the family connection found in many cultures while generating a valuable lesson on geometric tessellations and tiling patterns.

11. **MATH CENTERS.** Create math centers that include a vocabulary component, a review of basic skills for those who need refreshing, individual and group tasks to reinforce the math content, and mathematical enrichment. Centers should include an assessment and recording worksheet for easy maintenance as well as self-checking options on the activities in the center.

CULTURAL HARMONY STRATEGIES

1. **AWARENESS.** Teachers should learn the background and prior experiences of the students and be able to apply this information in the lesson. For example, when working with certain students, dominoes and card games are a regular activity in the home. Create classroom lessons about famous individuals from other countries. Try to remember that not every culture eats pizza, so vary your models to be sensitive to cultural differences.

2. **ACCEPTANCE.** Make sure the curriculum provides for cultural differences. Some countries focus heavily on computational skills, while others utilize more individual work. The methods used in the U.S. may appear foreign to the students. Differences in semantics apply as well. For instance, be aware that 7 and 0 may be crossed through at times, 4 may be opened or closed at the top, 2.500 may be written as 2,500 and division may be performed upside down rather than right side up. Adapt, individualize and modify your classroom while considering the student's level of content, language ability, mathematical expertise, or study skills.

3. **ABILITY LEVELS.** Teachers will find that many diversified levels of mathematical knowledge occur in ESL students. Students may be coming from countries that do not encourage mandatory schooling or they may be coming from countries that excel in the mathematical field. Pre-screening will provide valuable information about the academic abilities of your ESL students. Teachers must consider this diversity in ability levels in their instruction and assessments. Formulate lessons that include a variety of levels so students can obtain some form of success or individualize homework assignments for your students. For instance, include problems such as $121 - 34$ as well as $12 -$

8. It is important for the child to feel challenged yet successful and productive.

4. **PROCESS.** In some cultures, the process of finding the answer is not as valued as the final answer, so students coming from those cultures will have a difficult time realizing the teachers need for "showing the work". Teachers should discuss the U.S. emphasis of process as well as product. It is strange to some students who enter the U.S. when the teachers require them to "Show your work." This would be marked down in their home countries.

5. **PARENTAL INVOLVEMENT.** Encourage parent participation and reinforcement of concepts and basic facts. If they do not respond, check to see if bilingual social workers are available to make home visits or to interpret communications. Whenever possible, attempt to communicate in the native language with parents. Recognize that some cultures respond positively to teacher-parent interactions and are willing to participate actively in the school system while other cultures perceive the school as "the authority" and view direct contact with school personnel negatively.

EFFECTIVE INSTRUCTION STRATEGIES

1. **VISUALIZE IT.** Teachers should accentuate the visual side of mathematics. Incorporate prompts, cues, facial expressions, body language, visual aids during instruction. Use concrete manipulatives and an assortment of models to develop new concepts. Multi-embodiment is important so students can see the concept. This will minimize some of the abstraction. Students will begin to like math when they see it in the flesh.

2. **DRAW IT:** Making up concept maps to relate the new topics and words to things they may already know and understand will encourage scaffolding and inter connections within mathematics. For example, the base ten metric system is easier to learn than the customary units we teach in this country, especially when it comes to converting from one unit to another. By developing a concept map you will help students make the connections between what they know to what they need to learn for mathematics taught in the United States.

Metric U.S. Customary

Centimeters, meters, kilometers => length => inches, feet, yards, miles, grams, kilograms => weight => pounds, ounces, liters, kiloliters => measurement => cups, pints, quarts, gallons.

3. **SYMBOLIC MATH:** It is wise to begin teaching the mathematical symbols only after students have obtained the experiential background and the language development to understand the symbolic representation. Using less than versus $<$ requires that the student has experienced the concrete meaning of the concepts through the use of balances or pictures. In addition, the numerals, the most common of all math symbols, is a very abstract concept to learn. For example, 34, $\frac{3}{4}$, 3^4 , $3+4$, $3*4$, $3-4$, 3.4 are all numbers that have a unique meaning that can be considered highly abstract to a young inexperienced mind. Adding to this confusion, the same number can be represented in different ways such as 0.75, $\frac{3}{4}$, $\frac{75}{100}$, 75%. It is important to recognize that many countries represent the same number differently. For example, in the U.S. we use 7,500 to represent seven thousand five hundred. Other countries use 7 500 to represent that number: in other words, avoiding the use of commas to separate the decades.

4. **ASSESSMENT:** Using alternative assessment such as thinking aloud, presentations, interviews, observations, check-lists, reflective writing, self-assessment, drawings and portfolios will help to adequately assess and evaluate the students' work. This is especially important since proficiency in the written word develops slower than the spoken word. Encourage drawings that translate and visualize the problems. Encourage students to think aloud and to pair-share their ideas with others as they work through a problem. Encourage them to give oral explanations of their thinking process as they solve a problem in a non-threatening environment where students nurture and encourage open expression. Remember, a traditional test that requires competent English proficiency may not truly test the student's mathematical abilities. Unfortunately, the LEP student can be improperly placed in the wrong math class resulting in high levels of boredom or frustration.

5. **MODEL:** Be sure to model problem solving strategies through real life situations so they see you think through a problem and develop a purpose for the math learning they are involved in. The typical problem solving approach to model includes reading the problem,

understanding the problem, planning a strategy, solving the problem and verifying the answer. In addition, model the many problem solving strategies of acting out the problem, working backwards, guessing and checking, making a table, looking for a pattern, solving a simpler problem, changing your point of view, making a drawing, and systematically accounting for all possibilities so they become critical thinkers in mathematics and develop confidence in their problem solving abilities. Be careful not to make the problem solving process appear too easy for you. They need to realize that it is natural to attempt, think through, adjust ideas and try other approaches when one approach proves unsuccessful.

6. **HETEROGENOUS GROUPING:** Just as it would be inappropriate to group low students together, it is just as inappropriate to group students according to language preference or ability. Cooperative groups heterogeneously arranged can facilitate discussion and peer teaching if incorporated and monitored properly. However, when necessary, be sure to ask a more fluent English speaker to assist in translating instructions and questions or learning will be impaired otherwise.

7. **HANDS ON:** We all learn through different modalities, however many students at the public school setting prove to be more visual, tactile learners. They will learn best with the use of hands-on experiences involving concrete or mechanical aids that reinforce learning. Manipulatives, computers, calculators and tape recorders are good devices when selected and used appropriately to reach your academic objective.

8. **MINIMIZE ANXIETY.** The most important goal for any teacher should be to Create a comfortable, non-threatening environment for all your students. LEP sensitivity demonstrated from the teacher and the students will go a long way in helping the LEP student feel accepted and comfortable in the classroom.

By being aware of the above factors, you, the teacher, can make a difference for the ESOL student, by simply focusing on the literary strategies, cultural awareness strategies, and the effective teaching strategies. As you educate yourself about your students' cultural and academic backgrounds, you will be rewarded with a sensitivity and

respect for the diversity that exists within your classroom. Embrace the diversity within your classroom -don't deny it. Both you and your students will be enriched by the diverse experiences you can draw upon during your teaching of mathematics to ALL students.

THE AUTHOR

Dr. Sally Robison is an Assistant Professor of Mathematics Education at Florida Atlantic University in Boca Raton, Florida, USA. Her writing and research interests include Teaching Mathematics to ALL student (PreK–16), using technology to teach mathematics, misconceptions in mathematics, comparative studies in teaching mathematics, and best practices in mathematics, high stakes testing, and curricular issues in mathematics education (K-16).

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