Editor's Perspective Article: Mathematics Problem Solving, Literacy, and ELL for Alternative Certification Teachers

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Abstract

New teachers who entered the profession through alternative pathways often teach in high-need urban environments, which means there may be a significant number of English Language Learner (ELL) students in their classrooms. In order to best support these students, techniques can be employed to best facilitate learning for students who do not have English as their first language. Given the importance of reading problem solving in mathematics class, it is increasingly important that teachers support their ELL students' learning. This article will address problem solving and literacy in the ELL context, as well as provide strategies for new teachers to employ in the classroom.

Keywords: alternative certification, mathematics, problem solving, English Language Learners

The views expressed in this article are the editor's views and do not necessarily reflect the views of the National Association for Alternative Certification.

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Introduction

New teachers who enter the profession through alternative pathways often teach in high-need urban environments, which means they may be teaching a significant number of English Language Learner (ELL) students in their classrooms. In order to best support these students, techniques can be employed to best facilitate learning for students who do not have English as their first language. Given the importance of reading problem solving scenarios in mathematics class, it is increasingly important that teachers support their ELL students' learning. This article will address problem solving and literacy in the ELL context, as well as provide strategies for new teachers to employ in the classroom.

Mathematical Problem Solving

Reform-based mathematics instruction emphasizes problem solving instead of strictly focusing on computational mathematics as the way in which students learn best (Evans, 2014; National Council of Supervisors of Mathematics, NCSM, 1978; Posamentier & Krulik, 2008; Posamentier et al., 2008; Schoenfeld, 1985). The National Council of Teachers of Mathematics (NCTM, 2000) said, "Problem solving is not only a goal of learning mathematics but also a major means of doing so" (p. 52). In the Common Core Standards, which guides what every student should know and be able to do in mathematics and English language arts by each grade, there are three of the Standards for Mathematical Practice that are directly related to the literacy and mathematics connection: (1) Make sense of problems and persevere in solving them; (2) Construct viable arguments and critique the reasoning of others; and (3) Use appropriate tools and strategies (Common Core State Standards Initiative, 2014).

Literacy within Problem Solving

Imperative to learning mathematics through problem solving is for students to have strong literacy skills. In a classroom in which the primary emphasis is computation, language skills are not quite as critical as the case in which the focus is on reading a problem, interpreting the problem, solving the problem, and then expressing the solution in English. This means that if we adopt a reform-based mathematics classroom, which we ought to do, we could potentially put our ELL students at a distinct disadvantage, despite problem solving being one of the best means we have in educating our students in mathematics (Evans, 2014).

Krulik and Rudnick (1989) defined problem solving as a process in which an individual confronts an unfamiliar situation using prior knowledge, skills, and understanding to satisfy the demands of the unfamiliar situation. Polya (1945) provided a four-step approach to problem solving: 1) Understand the problem, 2) Make a plan, 3) Carry out the plan, and 4) Look back. Problem solving using real-world contexts places students within mathematics and language. For example, teachers could have students gather data from their own classmates for a statistical experiment (see example 1 below). Notice in the example that the results are presented in a visual form, and not necessarily in language. Another example could be teachers having students solve a real problem for the school such as how many raffle tickets must be sold in order to raise funds for a class trip. Additionally, students can determine how many buses are needed for the trip based upon the number of students going on the trip given a specific capacity for each bus

(see examples 2 and 3 below). Notice that while the problems are given in English language, they are based upon real student data and experiences to solve real problems of interest to the students. By having ELL students work with native English speaker students, or preferably bilingual students, the ELL students solve the mathematics problems in a real-world setting that are interesting, engaging, and furthers their use of English.

Using real-world settings means students use their own experiences, which do not depend on English language skills. The problem becomes more relevant if it depends less on their English language skills and more on their own life experiences. It should be noted that since the problems are presented in either written or verbal form, there is some degree of English proficiency needed. However, this can be mitigated by having students work together in collaborative groups.

Example 1:
Devise a way to determine the most popular bands listened to in your grade. Represent the results in a bar chart or a pie chart.

Example 2:
There are 67 students going on the class trip, and it costs $15 per student to go on the trip. The raffle contest prize is a gift card for $100. If a raffle ticket costs $5 each, how many raffle tickets must be sold in order to cover the trip and prize?

Example 3:
Each school bus seats 28 students. Three teachers and four parents will also go on the trip. How many school buses are needed for the class trip with 72 students attending? How many seats are left empty on the last bus if the seats on the other buses are completely full?

Support for ELL Students with Limited English Vocabulary

In order to reach ELL students whose vocabulary and understanding of English impeded their learning of mathematics, Winsor (2008) provided three strategies: students should write to communicate the mathematics they are learning, learn in collaborative groups, and engage in real-world learning. The first strategy was to engage students in reflective journal writing. Winsor allowed students to write in their journals in any language in which they were comfortable. Winsor used peer-assessment to evaluate the journals because there were enough students who were able to understand the second languages used in class. Having students evaluate other students' reflective journals develops capacity for feedback and allowed students to reflect in language in which they were most comfortable.

In addition to having students practice their writing skills, Winsor (2008) emphasized collaborative group work as a way to support student learning for ELL students. Winsor argued that there are many cases in which some students may speak another ELL student's language, and also be proficient in English. In this case, the bilingual student operates as a translator and also benefits from working in groups through exposure to other students' ideas. Similar to any collaborative group situation, the bilingual student benefits from having to understand the material enough to explain it to another student. An additional problem arises, however, when

there is an ELL student who is unique to the class in that no other students know the native language.

As a strategy in supporting vocabulary development, Winsor (2008) set up a grid with four quadrants (see Figure 8) using an example of learning about even numbers. In the top left corner Winsor had students write, for example, the concept in Spanish, "numeros pares" (in English this means, even numbers). In the top right corner the students use English, which is "even numbers." In the lower left corner students write in Spanish, "Son los multiples de dos" (in English this means, the multiples of two). In the lower right corner students write what this means, for example, 2, 4, 6, 8, 10, etc. The main idea here was students understood vocabulary and did not solely rely on memorization. This can be done with other mathematics concepts to support vocabulary development in the English language, and simultaneously it supports conceptual development in mathematics. The connections are made between native language, English, and mathematics.

ELL Word Square (Winsor, 2008)

Numeros pares	Even numbers
Son las multiples de dos	2, 4, 6, 8, 10

While mathematical problem solving and vocabulary can provide additional challenges to ELL students, they need not be an impediment to student learning, but rather problem solving and vocabulary can enhance their mathematics education, including the use of experiential learning. It is important that teachers use strategies, such as mentioned here, among others, in working with ELL students and to have them be successful in the mathematics classroom.

Conclusion

This article provided several strategies for new mathematics teachers to support the mathematics learning of ELL students contextualized in the framework of mathematics problem solving and literacy. Given that many mathematics teachers who enter the profession teach in high-need urban environments, often with ELL students in the classroom, strategies that will help teachers reach all students are critical for student achievement.

References

Common Core State Standards Initiative. (2014). *Standards for mathematical practice.* Retrieved from http://www.corestandards.org/Math/Practice/

Evans, B. R. (2014). Mathematics talk: Literacy development in a mathematics context. In F. Falk-Ross (Ed.), Language-based approaches to support reading comprehension (pp. 91-112). Lanham, MD: Rowman & Littlefield.

Krulik, S., & Rudnick, J. A. (1989). *Problem solving*. Boston, MA: Allyn and Bacon.

National Council of Supervisors of Mathematics. (1978). Position paper on basic mathematical skills. *Mathematics Teacher, 71*(2), 147-152.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

Polya, G. (1945). *How to solve it.* Princeton, NJ: Princeton University Press.

Posamentier, A. S., & Krulik, S. (2008). *Problem-solving strategies for efficient and elegant solutions grades 6-12.* Thousand Oaks, CA: Corwin Press.

Posamentier, A. S., Smith, B. S., & Stepelman, J. (2008). *Teaching secondary mathematics: Teaching and enrichment units* (8th ed.). Boston, MA: Allyn & Bacon.

Schoenfeld, A. (1985). *Mathematical problem solving.* New York, NY: Academic Press.

Winsor, M. S. (2008). Bridging the language barrier in mathematics. *Mathematics Teacher, 101*(5), 372-378.