



Teaching Math to English Learners

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Consider the following scenario. Early one Monday morning, a group of seventh-grade math students in Linda Escamilla's first-period class is preparing for the day's lesson. At one table, Halat takes out her notebook and the small dictionary that has become her constant companion since beginning school in the United States a few weeks earlier. She is used to needing a dictionary on occasion. After all, in Iraq her teachers used Arabic to conduct lessons instead of the Kurdish she spoke at home. Although she studied Arabic at the mosque, some of the words used in her school classes were unfamiliar. Halat eagerly wonders what the class will be doing today. She is happy to be in school again after the long months in the refugee camp in Jordan, where she began to wonder if she would ever realize her dream of studying hard to become a pediatrician. She likes her new school, although it has taken some time to get used to things. Back in Iraq, her teachers primarily lectured, and the girls in her class did not often talk together. Here it seems that the teacher talks very little. However, she is getting used to conversing with the other girls and boys in her group, and some of them have even begun to learn a few Arabic words.

Javier and Bao place their backpacks near the wall, playfully shoving each other as they return to their seats next to Halat. The boys have known each other since fourth grade, when they were in the same small group that met with Mr. Mendoza, the English as a Second Language (ESL) teacher, several times a week. Although they had attended the same elementary school since kindergarten, Javier had been in bilingual

classes off and on, so they didn't meet until upper grades when they began the ESL group together. Javier liked math. It had always been one of his favorite subjects and he especially liked working with the cubes or other materials that his teachers set out. However this year, he was beginning to change his mind. He found himself becoming sleepy when the teacher gave the class problems to read. The words just didn't make sense, even though he knew he could say most of them aloud. Bao, on the other hand, had never liked math very much. He decided he just wasn't good at it the way some people are. He particularly disliked the worksheets his sixth-grade teacher had sent home nearly every night with lots of story problems. Bao's parents spoke only Vietnamese, and although they tried, they were not able to help him often with those problems. He was even having more trouble understanding when his parents tried to explain some of the computation problems, too. Lately, he realized he was beginning to forget words in Vietnamese at times.

As the class gets underway, Bao looks at the clock. The students are taking an unusually long time this morning to settle in. Bao estimates that it won't be long until the 50-minute period will be over and it will be time to pack up his things again. He catches Javier's eye, points to the clock, and both boys give a thumbs-up sign.

Seated on the other side of Halat, Hugo also anxiously awaits the day's activity. Like Javier, Hugo has always loved math, and he excelled in math back home at school in Mexico. When he arrived in school in the United States in fifth grade, he was surprised to find that the students did not know how to do some of the problems he completed with ease. Even though he had been in school here a short time, he had made rapid progress in English in his bilingual classroom. When his teacher realized how quickly and accurately he completed his math lessons, she began to let him try more advanced problems in a math book written in Spanish. That makes him very happy, because if he is going to become an engineer like his uncle back in Mexico, he knows he is going to need to learn a lot of math. The only thing Hugo dislikes about math these days are those times when he has to work with other students. He hopes today isn't going to be one of them. He grows tired of the ways that Bao and Javier often play around, for example, and thinks that he would learn a lot faster if he could work by himself.

The remaining two girls at the table, Andrea and Kristin, also take out their notebooks and pencils. Andrea leans forward, her eyes scanning the board for instructions for the day's work. Like Hugo, she has always found math easy, and this year is no exception, so far. Learning English, too, had come easily for her. Although her family immigrated to

New York City when she was a young child, Andrea has always heard both English and Spanish at school and at home, and she even began her school years in a bilingual kindergarten in Puerto Rico. In fact, Andrea knows that many of her teachers this year in seventh grade do not even realize that she speaks Spanish. Sometimes she has begun to worry lately, however, when she finds herself unable to express her ideas in English as well as she knows she would be able to do in Spanish. Andrea is a very lively and outgoing girl. She becomes particularly frustrated when she senses that her English-speaking friends don't always understand her when she explains a math problem. She is even beginning to wonder if she really understands the problems herself.

Kristin, seated next to Andrea, slouches in her seat. Kristin is the lone member of the group who is a native English speaker. Like Javier, Kristin always loved math in elementary school. This year, however, she, too, has begun to dread math class, even though sometimes she is not sure why she feels that way. Usually, she understands what she is supposed to do, and on occasion is excited when she solves a complicated problem that stumps some of her friends. Yet she often feels embarrassed when she has to speak in class, and sometimes she fumbles when pronouncing some of the longer words. She finds herself nervously hoping that today will not be one of those days.

If you are a middle school math teacher, it is likely that you recognize aspects of this scenario from your own experience. Adolescent students bring a variety of skills and experiences to the mathematics classroom. The ways in which they learn and see themselves as students are influenced by factors ranging from the instructional practices of their elementary school teachers, their linguistic and experiential backgrounds, the goals they and their families have set for their futures, and the opportunities they have had to acquire academic language in English, or the kind of language that is used in secondary school-content classrooms and textbooks.

In addition, adolescent students are grappling with the development of their own identities at a time when peer relationships become even more important. Although they may be unable to articulate or even be fully aware of their perceptions, many students may begin to experience a host of societal pressures. These include the often-unspoken expectations of their teachers and their peers based on their gender, ethnicity, and individual personalities as well as on the socioeconomic status and educational backgrounds of their families. Within this complex landscape, students' facility with academic English plays a critical role. Language is intricately tied

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to students' sense of self as well as to the ways in which they are perceived by others. These perceptions influence adolescent students' engagement in mathematics, as the opening scenario illustrates. Access to academic English also clearly impacts students' opportunities for conceptual development in middle school settings where content instruction occurs in English. Although all these factors affect native English-speaking students (like Kristin in our scenario), students for whom English is a second (or third) language rely on school to develop both content

understanding and academic English. For this reason, attention to language in the math classroom is helpful for all students, but is critical to the success of English learners.

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Like most teachers, you have probably seen the numbers of English learners (ELs) increase at your school. It is also likely that the majority of these students are struggling with the content demands of mathematics for a variety of reasons. Although the overall math achievement of middle school students has improved steadily during the past few years, the same cannot be said for ELs. In fact, achievement data show that the performance of ELs in mathematics actually decreased between 2007 and 2009 (National Assessment of Educational Progress 2009).

This inequity is of grave concern, especially given the critical importance of mathematics to students' future academic success and life chances. It is an issue that can be addressed if teachers provide well-designed linguistic and conceptual support for their students.

Why should math teachers address English language development (ELD) during precious instructional time? After all, in most secondary schools across the United States, ELD has its own class period. And content-area teachers have learned strategies for helping ELs understand their lessons. Isn't the incorporation of visuals, the use of manipulatives, and a conscious effort to read word problems or other written materials aloud sufficient to address the needs of these students?

ELs do need to learn the content of their mathematics courses, but learning is mediated through language—in our case, the English language. Every part of learning is dependent upon language, from the arousal of curiosity, to the teacher's explanation of a concept, to the formation of an understanding and the verbalization or written expression of that understanding. Along the path from curiosity to demonstrated

understanding, a learner—any learner—needs to clarify her developing understanding, test hypotheses, and solicit confirmation of her thinking. All these activities are conducted through the medium of language.

Because of the importance of language in mathematical reasoning, the instructional strategies presented in this resource foster deeper understanding for native English speakers as well as for ELs. However, although the strategies are helpful for students who are proficient in English, they are essential for ELs. When a student is carrying out intensive cognitive work in a second language, limitations in language can lead to limitations in opportunities to learn. Therefore, the more linguistic support given to ELs in math class, the sooner they can enter and appreciate the world of mathematics, along with their native English-speaking peers.

This resource is intended to assist middle school math teachers in helping their students accomplish two goals: to develop proficiency in English and to develop mathematical understanding. To that end, the lessons in this resource seek to amplify rather than simplify the role of language in math class. The lessons and vignettes show different ways that teachers can explicitly structure experiences so that all students, especially ELs, can engage in conversations about math in English that promote better understanding of the content being taught.

To accomplish these goals, it is important for teachers to be aware of the factors that contribute to ELs' success in mathematics. These include the backgrounds and experiences that adolescent ELs bring to the classroom, how middle school-age students acquire a second language, the challenges ELs face when learning mathematics, the determination of the linguistic demands of a math lesson, and specific strategies and activities that simultaneously support learning English and learning mathematics with understanding.

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The Research: Backgrounds of Adolescent English Learners

There are approximately five million English learners enrolled in public schools in the United States (National Clearinghouse for English Language Acquisition 2010). That is more than 10 percent of the school