



# MATH INSTRUCTION FOR ENGLISH LANGUAGE LEARNERS

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## **Introduction:**

In the 2017-18 school year, 10.4% of all New York State Students were multilanguage learners (MLLs) or English language learners (ELLs) (“New York State Multilingual Learner/ English Language Learner (MLL/ELL) Data Report”, 2019). Over the 20 years preceding 2016, English Language Learners were the fastest growing subgroup in the United States K-12 education system (Doabler et al., 2016). As this subgroup continues to grow, schools struggle to support ELLs in achieving mathematical proficiency. This struggle to reach grade appropriate mathematical proficiency manifests in a math achievement gap between ELL students and Native-English speaking students. This gap becomes apparent in the early years of primary education and remains relatively steady throughout the public educational tenure of students (Doabler et al., 2016).

## **English Language Learner Math Students**

Doabler, Clarke, Kosty, Baker, Smolkowski, and Fien reference the idea that ELLs have a “double demand” in mathematical learning. This double demand consists of English language proficiency and mathematical language proficiency (Doabler et al., 2016). With mathematical language differing vastly from conversational English, a new English dialect must be learned in order to achieve mathematical comprehension in American public schools. The mathematical language expectations were exacerbated with the introduction of Common Core, which emphasized mathematical vocabulary and associated word problems (Doabler et al., 2016).

The 2014 published article “The relationship between mathematics and language: Academic implications for children with specific language impairment and English language learners” by Alt and Beal focused on establishing which type of mathematical problems were leading to the achievement gaps between ELL students and native English-speaking students (Alt et al., 2014). An assessment was given to ELL school aged students in English. The analysis of this assessment showed that the difference in mathematical achievement between the ELLs and native English-speakers could be attributed almost entirely to language heavy mathematical questions and the struggle ELL students had with those questions (Alt et al., 2014). Though the methodology of this particular project was fairly unambitious, the result was a clarification in the role of mathematical language in ELL achievement.

## **Spanish Specific English Language Learners:**

Spanish speaking students constituted 64.8% of all Multilanguage Learners and English Language Learners in NYS during the 2017-18 school year (“New York State Multilingual Learner/ English Language Learner (MLL/ELL) Data Report”, 2019). Hispanic children are less likely than their peers to be enrolled in Pre-K, which makes early primary school a crucial time for mathematical language emersion for many Spanish speaking students (Foster et al., 2018).

A 2012 study by Alt, Arizmendi, Beal, and Hurtado explored the significance of mathematical language for second grade Spanish speaking ELL students. In this study, students were given a math assessment in English. If a student got a question wrong, the question would be given to the student in Spanish, and they would be given another chance to answer it (Alt et al., 2012). The conclusion of this research was that mathematical assessments given in English for this group of students primarily tested English language skills, not math comprehension (Alt et al., 2012).

## **Solutions to English Language Learner Math Learning Gap:**

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A peer reviewed meta-analysis of this issue found four solutions that have helped to close the mathematical achievement gap between ELLs and their peers (Arizmendi et al., 2021). The first solution comes from a 2016 published paper written by Doabler, Clarke, Kosty, Baker, Smolkowski, and Fien. The intervention in this particular study was the introduction of the “Early Learning in Mathematics” curriculum, which focused on providing explicit and simple examples, rooted in a common understanding of English math vocabulary (Doabler et al., 2016). The ELL Kindergarteners who were the subject of this study saw substantial increases in mathematical competencies. This study helped to show the importance of language intensive mathematical instruction (Doabler et al., 2016).

Another possible solution for closing the ELL math achievement gap is the Building Block program. This software program was used by a subject group of kindergarteners and studied in 2018 by Foster, Anthony, Clements, Sarama, and Williams (Foster et al., 2018). The mathematical content delivered by the Building Block program was done so in Spanish. After the completion of the program, students overall improved their basic understanding of math, as reflected in a Spanish language math assessment (Foster et al., 2018). This program emphasized the importance of early math instruction and the strategy of eliminating the language barrier in these important lessons by delivering the material in Spanish. The theory presented is that introductory math lessons are too important to be impeded by language limitations.

Dynamic Strategic Math is another approach to assist ELLs in math knowledge development (Arizmendi et al., 2021). Dynamic Strategic Math targets word problems, which are particularly difficult for many ELL students. Dynamic Strategic Math focuses on teaching math vocabulary before the lesson and providing scaffolding for this process in the students’ native language (Arizmendi et al., 2021). In two different studies performed by Orosco 2nd and 3rd grade ELL students improved their math knowledge significantly through the use of Dynamic Strategic Math (Arizmendi et al., 2021).

Culturally and Linguistically Responsive Intervention with Schema Intervention or CLR-SI, is another math program for ELL students, which is delivered in English (Arizmendi et al., 2021). This program features a vocabulary and linguistics focus that does not neglect the student’s native language, but instead builds bridges between English mathematical language and linguistic concepts from the student’s native language (Arizmendi et al., 2021). Another strength of the CLR-SI program is that students are presented the information through relatable content focused on relevant cultural experiences and situations that reflect daily life. Use of the CLR-SI program produced positive outcomes in math word problem assessments for a study group of 3rd graders, with a resulting effect size of .79 (Arizmendi et al., 2021).

Though the Early Learning in Mathematics, Building Block, Dynamic Strategic Math and CLR-SI programs had positive impacts on ELL mathematical achievement, the meta-analysis of these strategies and others related to this topic, show an average effect size of .27 (Arizmendi et al., 2021). The What Works Clearinghouse uses a cut off point of .25 for effect sizes to signify directional significance, which indicates the positive effect of these ELL mathematical achievement supports had a positive effect. However, this effect was not large on average.

### **Implications for Teaching:**

A useful summary of the strategies utilized to close the mathematical achievement gap between ELL students and their peers is that limited mathematical vocabulary knowledge requires direct teaching of mathematical language, before progressively difficult topics can be explored (Powell et al., 2019). Some of the common elements of successful treatments relative to this topic include the following:

- Pre-teaching math vocabulary before lessons (Arizmendi et al., 2021)
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- Keeping a class glossary of math vocabulary terms (Arizmendi et al., 2021)
- Use native language as scaffolding for new math vocabulary building (Arizmendi et al., 2021)
- If a student does not have the language skills to understand integral math lessons in English, teach essential concepts in the student's native language (Foster et al., 2018)
- Be aware of the "Double Demand" many ELL students endure (Doabler et al., 2016)

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