Research Brief

Saxon Math and California English Learner's Math Performance

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Prepared By
Miriam Resendez, MA, Senior Researcher
Mariam Azin, PhD, President

PRES Associates, Inc.
For more information:
(307) 733-3255
info@presassociates.com

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Project Overview

Grounding of mathematics learning in academic language has tremendous implications for the growing population of ELLs in classrooms across the U.S.; many learners who struggle with reading also have difficulty with mathematics, mainly because of the language demands that are embedded within of each of these skills.

—Center for Instruction, 2006

English Learners (ELs) represent one of the fastest growing segments of the student population in the United States (Hakuta & Beatty, 2000). In California alone, ELs exceed 19% of the student population in public schools (California Department of Education [CDE], 2006). As a result of rising numbers of ELs in U.S. schools and the No Child Left Behind Act (NCLB) of 2001, there has been an increasing interest in the academic performance of ELs.

Unfortunately, results show that in the United States, there has been a consistent trend of low math performance among English Learners. For example, while 39% of fourth graders scored at or above the proficient level in mathematics on the 2005 National Assessment of Educational Progress (NAEP), only 11% of ELs reached this performance threshold (National Center for Educational Statistics [NCES], 2006). Results do not appear to improve as students progress into the higher grade levels either. While 31% of eighth graders scored at or above proficiency on the NAEP, only 6% of English Learners did so. Similar trends surface in California as welll. Recent state assessment results show that while over one half of English Proficent students (56%) in Grades 2 through 7 were proficient in math on the *California Standards Test* (CST), less than one third of ELs (29%) were proficient (CDE, 2006).

Given that the ability to engage in critical thinking skills and solve mathematical problems is critical to success in today's complex work environment, the low performance of English Learners is cause for concern. Indeed, research has shown that a strong foundation of math skills early on is critical to students' participation in higher level math courses as well as to their future academic and career success (National Research Council, 2001).

In an effort to improve mathematical understanding of all students, John Saxon developed the *Saxon Math* program in the 1980s. Based on several research-based strategies to promote student success, the program uses incremental development and continual review to teach students math concepts. Saxon's instructional approach breaks complex concepts into related increments, with the idea that smaller pieces of information are easier to digest and, subsequently, retain. Thus, the incremental approach provides students with time to solidify prerequisite concepts and skills before they are introduced to the next step of instruction. Through continual review, previously taught concepts are practiced frequently and extensively over the course of the school year. The ultimate goal is that students build knowledge of math concepts over time, and that such concepts are built upon and reinforced on an ongoing basis.

Given how important math skills are to the future success of EL students, programs that help in the development of these skills need to be looked at carefully to determine their effectiveness. Indeed, NCLB mandates that educational materials purchased with public funds be proven by scientific research to improve student achievement in the classroom.

Planning, Research, and Evaluation Services (PRES Associates),[1] recently conducted analyses using California state assessment data to examine the relationship between the use of *Saxon Math* and math performance among elementary and middle school students in California. This research brief focuses upon the relationship between *Saxon Math* use and math performance in EL students[2] within

[1] PRES Associates is an external, independent, educational research firm with more than 15 years of experience in applied educational research and evaluation. For more information, please visit www.presassociates.com.

[2] These analyses included a subset of ELs and non-ELs. That is, due to extensive missing data (approximately 43,000) associated with the EL status variable obtained from the California Department of Education, unidentifiable ELs and non-ELs are excluded.

elementary and middle schools in the State of California. Please note that a full report is also available.[3] For more detailed information on the study, including methods, samples, sites, curricula, and detailed statistics, the reader is referred to this full report.

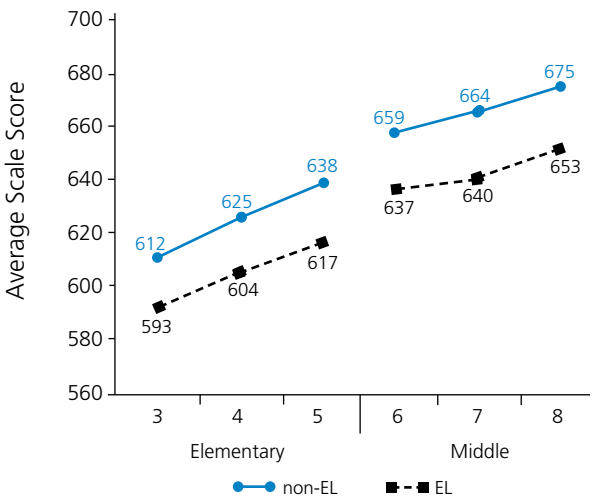
Results

Key findings organized by the evaluation question of interest follow. The first question focuses upon student performance trends among EL students in California schools using the *Saxon Math* program.

1. Are there significant changes in math performance among English Learners using *Saxon Math*?

Figures 1 and 2 show the patterns in the California Achievement Test, Sixth Edition (CAT 6) and the Stanford Achievement Test, Ninth Edition (Stanford 9) math performance for students who were English Learners and non-ELs. Results showed that, on all norm-referenced state assessment measures used in California, English Learners using *Saxon Math* in elementary and middle school grade levels showed significant improvement in math performance as they progressed from one grade level to the next, $p < .05$.[4] In addition, on the Stanford 9 assessment, there was a significant interaction between EL status and grade. Specifically, as shown in Figure 2, Saxon elementary and middle school EL students started off with lower math performance and then subsequently outperformed non-EL students. This suggests a closing of the achievement gap between EL and non-EL students in schools using *Saxon Math*.

Figure 1.
Saxon Math students: CAT 6 (2003–2004) math performance by English Learner status.



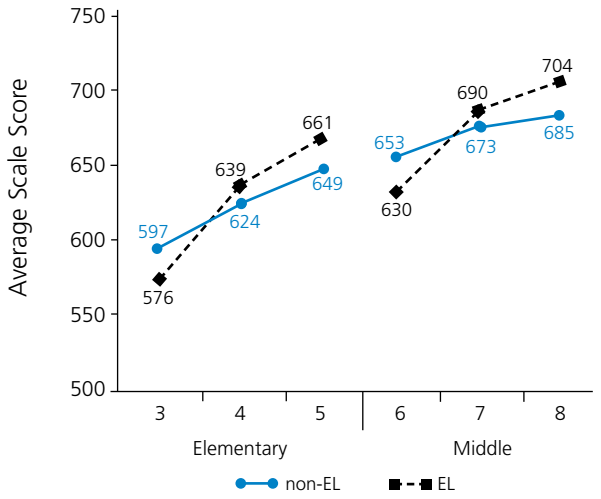
Note. F for change among ELs from third to fourth (1, 3090) = 49.92, $p < .001$. F for change among ELs from fourth to fifth (1, 2549) = 47.23, $p < .001$. F for change among ELs from sixth to seventh (1, 3164) = 9.53, $p < .001$. F for change among ELs from seventh to eighth (1, 2794) = 64.86, $p < .001$.

On the CAT 6, ELs and non-ELs using *Saxon Math* show increasing math performance as they progress from one grade level to the next.

[3] The full report, *The Relationship Between Using Saxon Elementary and Middle School Math and Student Performance on California Statewide Assessments* (Resendez & Azin, 2006), is available from PRES Associates.

[4] Statistical significance is usually determined at the threshold of .05 level or below. "Significant" means that we can be 95% or more confident that the observed differences are real.

Figure 2.
Saxon Math students: Stanford 9 (2001–2002) math performance by English Learner status.



Note. F for interaction at elementary level (2, 5267) = 63.48, $p < .001$. F for interaction at middle school level (2, 8190) = 143.26, $p < .001$. F for change among elementary ELs (2, 1064) = 530.13, $p < .001$. F for change among middle school ELs (2, 1399) = 726.71, $p < .001$.

On the Stanford 9 assessment, EL students in schools using *Saxon Math* started off performing lower than non–EL students but surpassed them over time.

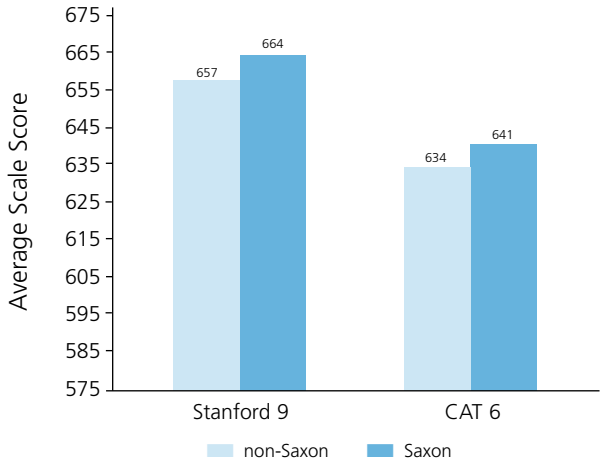
EL and non-EL students using *Saxon Math* show significant improvement in math performance over time, as measured by California statewide assessments.

2. Are there differences between English Learners using *Saxon Math* and those not using *Saxon Math*?

Analyses were conducted to determine whether there were significant differences in performance between EL students in Saxon schools as compared to EL students in non–Saxon schools.[5] Overall, analyses among English Learners showed that math performance differed significantly by group among elementary and middle school students, $p < .05$. This means that in general, among EL students, Saxon students had higher math performance compared to non–Saxon students.

At the middle school level, a consistent pattern of higher performance among EL students in Saxon schools as compared to schools using other math curricula was observed. That is, across all California statewide assessments, including the two norm-referenced tests (see Figure 3) and the criterion-referenced California Standards Test (see Figure 4), middle school English Learners who used *Saxon Math* showed better performance than those not using *Saxon Math*.

Figure 3.
Saxon Math and non-*Saxon Math* students: Middle school math performance on norm-referenced tests by English Learners.

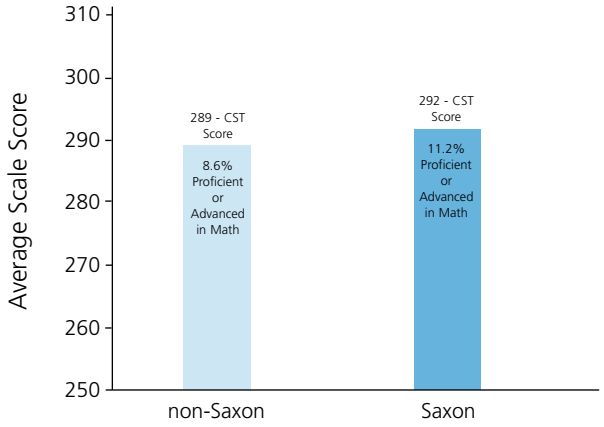


Note. Statistic for Stanford 9: $t(5797) = 9.68$, $p < .001$. Statistic for CAT 6: $t(23007) = 12.08$, $p < .001$.

On the two norm-referenced tests (Stanford 9 and CAT 6) used in California, middle school, EL students using *Saxon Math* showed significantly higher performance than students not using *Saxon Math*.

[5] Note that the design employed a matching procedure such that Saxon and non-Saxon schools were matched on important characteristics (i.e., CDE school characteristics index). See the full report (Resendez & Azin, 2006) for more information on this methodology.

Figure 4.
Saxon Math and non-*Saxon Math* students: Middle school math performance on *California Standards Test* by English Learners.



Note. Statistic for CST scale score: $t(33621) = 5.90$, $p < .001$.

On the criterion-referenced California Standards Test, middle school EL students using *Saxon Math* had higher math performance and were more proficient or advanced than ELs not using Saxon.

Among elementary students, results were not consistent (see Figures 5 and 6). Specifically, EL students using *Saxon Math* showed higher math performance as measured by the CAT 6, the latest norm-referenced test being used in California. However, on the Stanford 9 and the California CST, non-Saxon English Learners showed higher performance. Therefore, the better performance among EL students using *Saxon Math* is more evident at the middle school level than at the elementary level.

Figure 5.
Saxon Math and non-*Saxon Math* students: Elementary school math performance on norm-referenced tests by English Learners.

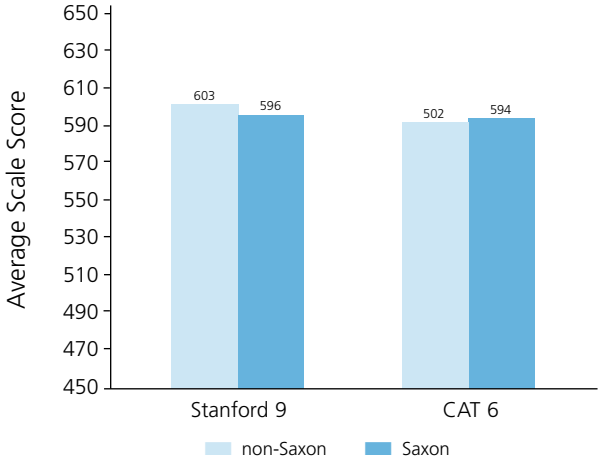
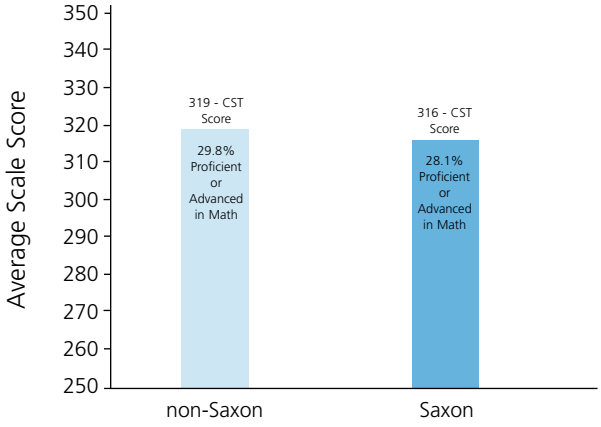


Figure 6.
Saxon Math and non-*Saxon Math* students: Elementary school math performance on *California Standards Test* by English Learners.



Note. Statistic for CST scale score: $t(49282) = 4.68$, $p < .001$.

Among elementary students, results were not as consistent. While EL students using *Saxon Math* performed better on the CAT 6 than ELs not using Saxon, non-Saxon ELs outperformed Saxon students on the Stanford 9 and CST.

Summary

The results show that EL students in schools that used *Saxon Math* show significant improvement in performance over time, as measured by California statewide assessments. In addition, English Learners who use *Saxon Math* tend to perform better than ELs not using *Saxon Math*; this finding is most evident at the middle school level. The consistency of the results across multiple assessments and grade levels speaks towards the generalizability of results and increases confidence in these findings. In sum, these findings suggest that *Saxon Math* is a promising program that can enhance the math performance of EL students.

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