Intervention based on science of reading and math boosts comprehension and word problem-solving skills

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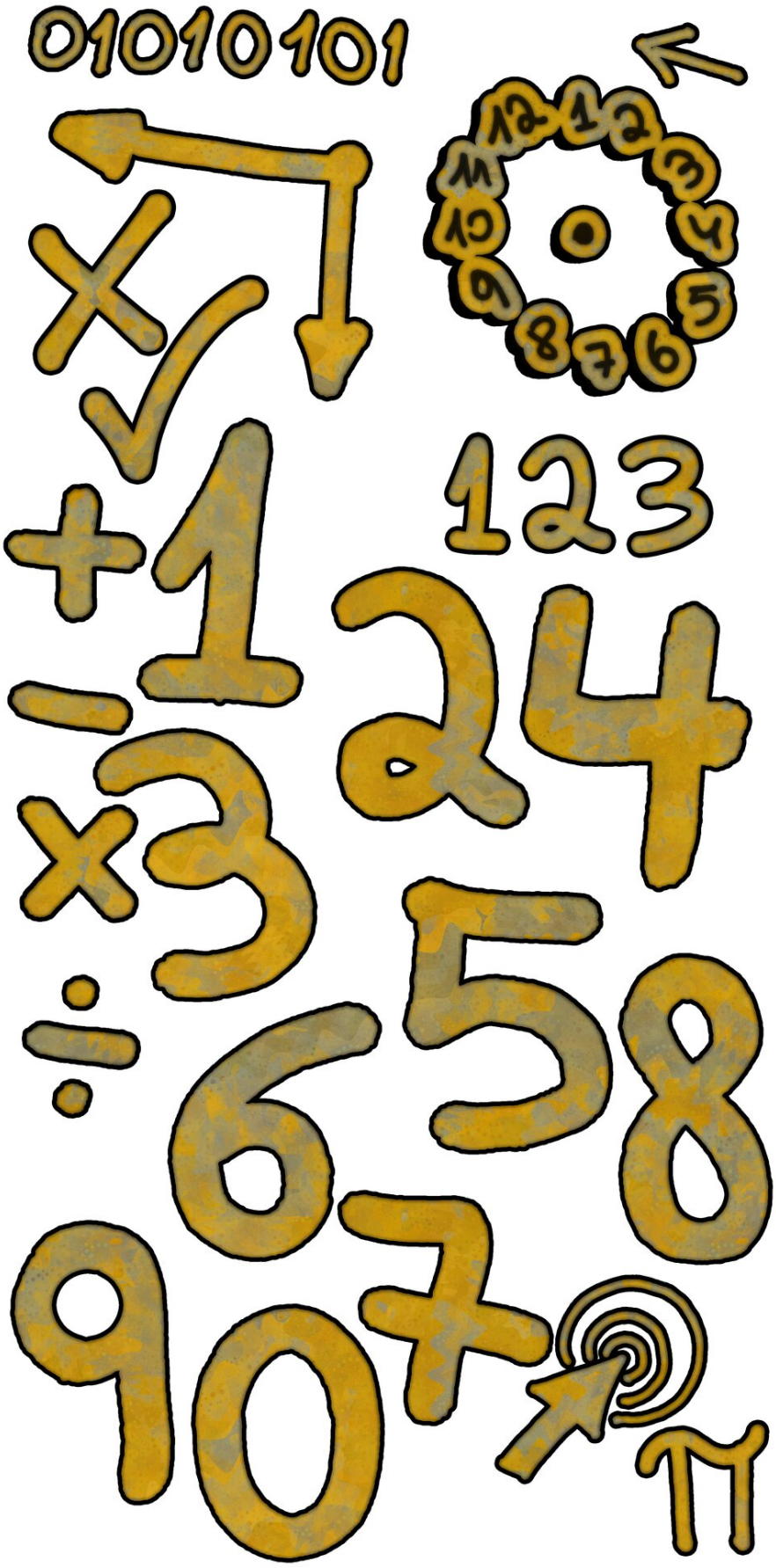
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New research from the University of Kansas has found that an intervention based on the science of reading and math effectively helped English learners boost their comprehension, visualize and synthesize information, and make connections that significantly improved their math performance.

The intervention, performed for 30 minutes twice a week for 10 weeks with 66 third-grade English language learners who displayed math learning difficulties, improved students' performance when compared to students who received general instruction. This indicates that emphasizing cognitive concepts involved in the science of reading and math are key to helping students improve, according to researchers.

"Word problem-solving is influenced by both the science of reading and the science of math. Key components include number sense, decoding, language comprehension and working memory. Utilizing direct and explicit teaching methods enhances understanding and enables students to effectively connect these skills to solve math problems. This integrated approach ensures that students are equipped with necessary tools to navigate both the linguistic and numerical demands of word problems," said Michael Orosco, professor of educational psychology at KU and lead author of the study.

The intervention incorporates comprehension strategy instruction in both reading and math, focusing and decoding, phonological awareness, vocabulary development, inferential thinking, contextualized learning and numeracy.

"It is proving to be one of the most effective evidence-based practices available for this growing population," Orosco said.

The study, co-written with Deborah Reed of the University of Tennessee, was published in the journal *Learning Disabilities Research and Practice*.

For the research, trained tutors implemented the intervention, developed by Orosco and colleagues based on cognitive and culturally responsive research conducted over a span of 20 years. One example of an intervention session tested in the study included a script in which a tutor examined a word problem explaining that a person made a quesadilla for his friend Mario and gave him one-fourth of it, then asked students to determine how much remained.

The tutor first asked students if they remembered a class session in which they made quesadillas and what shape they were, and demonstrated concepts by drawing a circle on the board, dividing it into four equal pieces, having students repeat terms like numerator and denominator. The tutor explains that when a question asks how much is left, subtraction is required. The students also collaborated with peers to practice using important vocabulary in sentences. The approach both helps students learn and understand mathematical concepts while being culturally responsive.

"Word problems are complex because they require translating words into mathematical equations, and this involves integrating the science of reading and math through language concepts and differentiated instruction," Orosco said. "We have not extensively tested these approaches with this group of children. However, we are establishing an evidence-based framework that aids them in developing background knowledge and connecting it to their cultural contexts."

Orosco, director of KU's Center for Culturally Responsive Educational Neuroscience, emphasized the critical role of language in word problems, highlighting the importance of using culturally familiar terms. For instance, substituting "pastry" for "quesadilla" could significantly affect comprehension for students from diverse backgrounds. Failure to grasp the initial scenario could impede subsequent problem-solving efforts.

The study proved effective in improving students' problem-solving abilities, despite covariates including an individual's basic calculation skills, fluid intelligence and reading comprehension scores. That finding is key, as while ideally all students would begin on equal footing and there would be few variations in a classroom, in reality, covariates exist and are commonplace.

The study had trained tutors deliver the intervention, and its effectiveness should be further tested with working teachers, the authors wrote. Orosco said professional development to help teachers gain the skills is necessary, and it is vital for teacher preparation programs to train future teachers with such skills as well. And helping students at the elementary level is necessary to help ensure success in future higher-level math classes such as algebra.

The research builds on Orosco and colleagues' work in understanding and improving math instruction for English learners. Future work will continue to examine the role of cognitive functions such as working memory and brain science, as well as potential integration of artificial intelligence in teaching math.

"Comprehension strategy instruction helps students make connections, ask questions, visualize, synthesize and monitor their thinking about word problems," Orosco and Reed wrote. "Finally, applying comprehension strategy instruction supports ELs in integrating their

reading, language and math cognition…. Focusing on relevant language in word problems and providing collaborative support significantly improved students' solution accuracy."

More information: Michael J. Orosco et al, Supplemental intervention for third-grade English learners with significant problem-solving challenges, *Learning Disabilities Research & Practice* (2024). DOI: 10.1177/09388982241229407

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