Students' understanding of the equal sign not equal, prof says

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Taken very literally, not all students are created equal — especially in their math learning skills, say Texas A&M University researchers who have found that not fully understanding the "equal sign" in a math problem could be a key to why U.S. students underperform their peers from other countries in math.

"About 70 percent of middle grades students in the United States exhibit misconceptions, but nearly none of the international students in Korea and China have a misunderstanding about the equal sign, and Turkish students exhibited far less incidence of the misconception than the U.S. students," note Robert M. Capraro and Mary Capraro of the Department of Teaching, Learning, and Culture at Texas A&M.

They have been trying to evaluate the success of math education through students' interpretation of the equal sign. They have published several articles on this topic, with the most recent one published in the February 2010 issue of the journal *Psychological Reports*.

Students who exhibit the correct understanding of the equal sign show the greatest achievement in mathematics and persist in fields that require mathematics proficiency like engineering, according to their research.

"The equal sign is pervasive and fundamentally linked to mathematics from kindergarten through upper-level calculus," Robert M. Capraro says. "The idea of symbols that convey relative meaning, such as the equal sign and "less than" and "greater than" signs, is complex and they

serve as a precursor to ideas of variables, which also require the same level of abstract thinking."

The problem is students memorize procedures without fully understanding the mathematics, he notes.

"Students who have learned to memorize symbols and who have a limited understanding of the equal sign will tend to solve problems such as 4+3+2=( )+2 by adding the numbers on the left, and placing it in the parentheses, then add those terms and create another equal sign with the new answer," he explains. "So the work would look like 4+3+2=(9)+2=11.

"This response has been called a running equal sign — similar to how a calculator might work when the numbers and equal sign are entered as they appear in the sentence," he explains. "However, this understanding is incorrect. The correct solution makes both sides equal. So the understanding should be 4+3+2=(7)+2. Now both sides of the equal sign equal 9."

One cause of the problem might be the textbooks, the research shows.

The Texas A&M researchers examined textbooks in China and the United States and found "Chinese textbooks provided the best examples for students and that even the best U.S. textbooks, those sponsored by the National Science Foundation, were lacking relational examples about the equal sign."

Parents and teachers can help the students. The two researchers suggest using mathematics manipulatives and encourage teachers "to read professional journals, become informed about the problem and modify their instruction."

Provided by Texas A&M University