

Learning fractions and division early will help America's students as they tackle tougher problems ahead, a research study finds

Formula written for math success

By Mary Niederberger
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Mastery of fractions and early division is a predictor of students' later success with algebra and other higher-level mathematics, based on a study done by a team of researchers led by a Carnegie Mellon University professor.

That means more effective teaching of the concepts is

needed to improve math scores among U.S. high school students, which have remained stagnant for more than 30 years.

The study, called "Early Predictors of High School Mathematics Achievement," was published recently in Psychological Science, and the lead researcher was Robert Siegler, a professor of cognitive psychology at CMU whose

work focuses on children's mathematical and scientific thinking.

"This has really important policy implications. Everyone is aware that overall U.S. math achievement isn't very good in relative terms or compared to other parts of the world. But there has been disagreement on what we need to focus on in math education," Mr. Siegler said. "This shows we really

need to focus on whole number division and fractions and teaching them better than we are currently doing."

Mr. Siegler said the changes in math education need to take place at the universities that train teachers, in professional development programs for current math teachers and in the elementary classrooms where

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Math study gives formula for success

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students are learning fractions and early division concepts.

The study, funded by the U.S. Department of Education and National Science Foundation, noted that math scores on national standardized tests among U.S. high school students have not improved in three decades and are significantly behind those in countries such as China, Japan, Finland, the Netherlands and Canada at a time when math proficiency is a requirement for many jobs.

It also noted that students who "start ahead in math generally stay ahead" and that those who "start behind generally stay behind" and it looked to find the reason.

Mr. Siegler's team of eight researchers hypothesized that 10-year-olds' knowledge of fractions would predict their algebra knowledge and overall mathematics achievement at age 16, even after statistically controlling for other factors such as general intellectual ability and family income and education.

The hypothesis came from earlier work that Mr. Siegler did in 2006-08 as a member of the National Mathematics Advisory

Panel, which suspected a link between fractions mastery and success in algebra and other higher level math courses.

The research team set out to examine mathematical knowledge in students from fifth grade through high school. It used two previous studies, one from the United Kingdom that provided a sample of 3,677 children born in the U.K. in a single week in 1970 and one from the United States that provided a sample of 599 children.

The children in the U.K. study were tested in 1980 when they were 10 and again in 1986 when they were 16. The U.S. children were tested in 1997, when they were 10 to 12 years old and again in 2002, when they were 15-17.

In the U.K. data, fractions knowledge at age 10 was the strongest math predictor of algebra knowledge at age 16 and overall math achievement. Results were similar in the U.S. data.

The study said a likely reason for U.S. students' weakness in fractions and division could be linked to their teachers' "lack of a firm conceptual understanding" of the concepts, citing several other studies in which many American teachers were unable to explain the reasons

behind mathematical solutions, while most teachers in Japan and China were able to offer two or three explanations.

"Any effort to improve the children's understanding without improving the teacher's understanding is doomed to fail," Mr. Siegler said.

He said one change that could be made at the university level would be to have elementary math teachers focus more on courses that will help them to understand elementary math rather than requiring them to take high-level math courses that don't apply to elementary school.

Mr. Siegler said he expects the study's funders to promote the changes.

Rob Ochsendorf, program officer for special education research at the U.S. Department of Education's Institute for Special Education Research, said of the study: "The results provide important cues to educators and researchers regarding the skills that are ripe for intervention in order to improve overall mathematics in the U.S."

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