

**ZMATH 2016f.00889**

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**Children's multiplication and division shortcuts: increasing shortcut use depends on how the shortcuts are evaluated.**

Learn. Individ. Differ. 49, 297-304 (2016).

Summary: The goals of this study were to investigate whether children's use of two arithmetic shortcuts based on the understanding of the operations of multiplication and division could be increased and to examine how children's evaluations of the shortcuts interacted with the brief task aimed at promoting shortcut use. Grade 6, 7, and 8 students solved two sets of inversion (e.g.,  $d \times e \div e$ ) and associativity (e.g.,  $d \times e \div f$ ) problems. Children with a good understanding of the relation between multiplication and division can use conceptually-based shortcuts to solve both types of problems. Students were also given a brief task demonstrating the inversion shortcut (the answer is the first number and no calculations are required) and the associativity shortcut (dividing first and then multiplying) and were asked to compare each shortcut to a left-to-right procedure (i.e., multiplying and then dividing). Half the participants were given the demonstration task between the problem sets and the other half after the sets. Inversion and associativity shortcut use increased by Grade 8 and improved across problem sets for both the Demonstration Middle and Demonstration Last groups. The demonstration task successfully promoted subsequent shortcut use but the participants who positively evaluated the shortcuts compared to the left-to-right procedure in the demonstration task had greater subsequent shortcut use. Conceptually-based shortcut use on multiplication and division problems was increased using a brief demonstration task but children's subsequent use of shortcuts depended on their evaluations of the shortcuts.

*Classification:* F33 C33

*Keywords:* arithmetic; inversion; associativity; conceptual knowledge; multiplication; division

doi:10.1016/j.lindif.2016.06.014