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Children's understanding of additive concepts.

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Summary: Most research on children's arithmetic concepts is based on one concept at a time, limiting the conclusions that can be made about how children's conceptual knowledge of arithmetic develops. This study examined six arithmetic concepts (identity, negation, commutativity, equivalence, inversion, and addition and subtraction associativity) in Grades 3, 4, and 5. Identity ($a - 0 = a$) and negation ($a - a = 0$) were well understood, followed by moderate understanding of commutativity ($a + b = b + a$) and inversion ($a + b - b = a$), with weak understanding of equivalence ($a + b + c = a + [b + c]$) and associativity ($a + b - c = [b - c] + a$). Understanding increased across grade only for commutativity and equivalence. Four clusters were found: The Weak Concept cluster understood only identity and negation; the Two-Term Concept cluster also understood commutativity; the Inversion Concept cluster understood identity, negation, and inversion; and the Strong Concept cluster had the strongest understanding of all of the concepts. Grade 3 students tended to be in the Weak and Inversion Concept clusters, Grade 4 students were equally likely to be in any of the clusters, and Grade 5 students were most likely to be in the Two-Term and Strong Concept clusters. The findings of this study highlight that conclusions about the development of arithmetic concepts are highly dependent on which concepts are being assessed and underscore the need for multiple concepts to be investigated at the same time.

Classification: F32 F33 C32 C33

Keywords: arithmetic; conceptual knowledge; addition; subtraction; identity; negation; commutativity; inversion; associativity; equivalence

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