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**Examining 5th grade students' ability to operate on unknowns through their levels of justification.**

Lindmeier, Anke M. (ed.) et al., Proceedings of the 37th conference of the International Group for the Psychology of Mathematics Education "Mathematics learning across the life span", PME 37, Kiel, Germany, July 28–August 2, 2013. Vol. 2. Kiel: IPN–Leibniz Institute for Science and Mathematics Education at the University of Kiel (ISBN 978-3-89088-288-8). 185-192 (2013).

Summary: The study examines students' ability to operate on unknowns through students' levels of justification in generalized arithmetic tasks in which algebraic expressions are present. Two tasks about generalization of properties of numbers were administered to 73 fifth-grade elementary school students and then 10 semi-structured interviews were carried out. Results indicate that a respectable percentage of students can operate on one unknown by providing generalizable arguments about the result of an "unknown even number + 3" without the need of reducing abstraction. On the contrary, most of the students face difficulties to think at an abstract level when confronted with the operation that involves two unknowns and provide numerical examples as justifications. Implications of these findings are discussed.

*Classification:* H23 C33 C43

*Keywords:* levels of justification; students' ability; operating on unknowns; algebraic expressions