

# 7<sup>TH</sup> GRADE STUDENTS' AND MATHEMATICS TEACHERS' SOLUTIONS IN ALGEBRAIC EXPRESSIONS - (8+4)÷(4-3)·2 = 24 (OR 6)

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The syntactic rules of algebra operate on two levels (Kirschner, 1989). The first level of the rules consists of working with parsing symbols such as parentheses, brackets and braces. The second level consists of the rules about the order of operations. The omission of the multiplication symbol in algebraic expressions may be a source of errors in the order of operations (see Bush, & Karp, 2013). In this presentation we focus on how 7<sup>th</sup> grade students and mathematics teachers handled the omitted multiplication symbols and the rules for the order of operations.

The student sample consisted of 121 students (58 boys, 63 girls) whose ages were between 13 and 15. The teacher sample comprised 21 mathematics teachers who participated in a professional development program on the assessment of mathematical knowledge. The algebra test used consisted of 28 items and had an appropriate reliability (Cronbach's  $\alpha = .84$ ).

On the item  $(8+4) \div (4-3) \cdot 2$ , students outperformed math teachers (93% vs. 76% performance rate). The item on whether the  $15x \div 3x$  expression is equivalent with  $15 \cdot x \div 3 \cdot x$  resulted in 17% performance rate among students, and 52% among teachers. In several cases the omitted multiplication symbol was handled as a grouping symbol.

“Students and teachers should be taught to write parentheses to provide clarity and avoid ambiguities as mathematicians do” (Barbeau, 2008 p. 381). It is recommended that Textbooks and teacher training programs should make the role of the omitted multiplication symbol more explicit.

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## References

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