

How sixth graders' represent some mathematics concepts with drawings

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Visual representations enable teachers and researchers to interpret the meanings of mathematical concepts, relations and processes; therefore, they play an important role in mathematics education. In the present study, we analysed the students' understanding of various mathematical concepts using drawings. Numerical expressions $17 - 9$, $3 \cdot (4 + 5)$, $\frac{3}{5}$ of 15 and 2^3 were provided to sixth grade elementary students ($N = 1595$). Students were asked to draw one picture for each numerical expression that describes it. We were interested in whether pictures adequately represent the concept underlying the expression. The data were analysed with a combination of qualitative and quantitative methods. The results show that the participants represented the concepts quite adequately. Expectedly, less abstract concepts were depicted more adequately. In the qualitative content analysis, two themes emerged. Those themes illustrate two ways of mathematical understanding (instrumental and relational) and two types of mathematical knowledge (procedural and conceptual). Procedurally oriented images predominated; they were also more prone to arithmetic errors. The research results can help researchers to create new research tools to measure students' mathematical understanding and help teachers to find new approaches that give them insight into students' mathematical understanding.

Keywords: visualisation, representation, understanding, subtraction, parenthesis, fraction, exponentiation.