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Investigating students' modes of thinking in linear algebra: the case of linear independence.
Int. J. Math. Teach. Learn. 2015, 22 p., electronic only (2015).

Summary: Linear algebra is one of the most challenging topics to learn and teach in many countries. To facilitate the teaching and learning of linear algebra, priority should be given to epistemologically analyze the concepts that the undergraduate students have difficulty in conceptualizing and to define their ways of reasoning in linear algebra. After the initial conditions are granted, pedagogical arrangements should be made. From this point of view, this study aims to explore undergraduate students' ways of thinking while solving problems in the abstract mode about linearly independent/dependent vectors. It also focuses on what students understood about linear independence/dependence concepts. The study was conducted with 186 mathematics teacher-candidates. The responses of these students to four problems and interview data conducted with eight students were used to identify a student's way of thinking. During qualitative analysis of the responses, *A. Sierpinska*'s [in: On the teaching of linear algebra. Dordrecht: Kluwer Academic Publishers. 209–246 (2000; ME 2016a.00721)] framework for thinking modes was adopted by the researcher. The content analysis revealed 15 categories of thought modes: 12 arithmetic, 2 geometric, and 1 structural. In arithmetic thinking mode (approximately 68% of the participants), the majority of students presented inappropriate solutions, including mistakes related to operational procedures for the problems in the abstract mode. The responses in geometric thinking mode (10%) were indicators of obstacles related to mathematical generalization. Furthermore, the response ratio in structural mode of thinking was very low (5%). In conclusion, the findings support the view of the inconsistency between the thinking modes of students and the abstract nature of linear algebra problems.