

Algebraic thinking regarding different mathematical contents within early algebra

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An ongoing literature review is conducted regarding algebraic thinking and early algebra, delimited to students younger than 12 years and to different mathematical contents. Questions asked to the review are how algebra can be used to enhance mathematical contents, and how algebraic thinking is manifested together with these young students. A tentative result shows that among 40 articles of totally 500 are presenting algebraic thinking regarding some specific mathematical content. Indications are that algebra is manifested as notations using other symbols than numbers, verbal arguments, and gestures that make these arguments more explanatory. Algebra related specifically to number sense is manifested as operations with unknown, general pattern, and variables.

When you are interested in the learning activity theory regarding mathematics you are also interested in using algebra as a tool when teaching younger students mathematics (Davydov, 2008). The learning activity theory is connected to learning about theoretical concepts (ibid.), and, regarding mathematics, algebra is taken as the core and the theory of mathematics (Krutetskii, 1976). Therefore, in a learning activity, algebraic symbols and foundation of algebra are important tools to use, to develop models to reflect on mathematical concepts, also together with the youngest students (Davydov, 2008).

Common strands of algebraic thinking in early algebra is according to researchers in the field: to express generalisation, formalisation, and to symbolising (e.g., Kieran, 2018). One way to explain algebraic thinking is as two core aspects of algebra: (A) Algebra as systematically symbolizing generalizations of regularities and constraints, and, (B) Algebra as synthetically guided reasoning and actions on generalizations expressed in conventional symbol systems (Kaput, 2008). A question to ask is, grounded in the interest of learning activity theory and the explanations of algebraic thinking, if there are research discussing algebra as a tool to develop understanding of other mathematical concepts? If there is, what is algebraic thinking then described as? The aim for a literature review is, therefore,

to ask earlier research about algebraic thinking that is involved in the development of other mathematics concepts in teaching together with the youngest students, and the aim for this presentation is to discuss the design of such review.

An ongoing literature review is conducted with the keywords early algebra and algebraic thinking in the pedagogical database the Education Resource Information Center, ERIC. The headings and the abstracts of 501 articles that were found were collected to a word document. From this document, articles for further analyses were chosen in manual selections regarding the age of the participants, if the articles were focusing on any mathematical content, and if they were answering any research question. Thirty-nine articles were catalogued according to the NCTM (2000) contents strands list. A tentative result so far shows that algebraic thinking regarding algebra itself is manifested as analyses of mathematical situations with other symbols than numbers only, with the use of verbal arguments and gestures to verify the analyses. Algebraic thinking regarding number sense is manifested as operations with unknown quantities, exploring general arithmetic pattern, and understanding variables. Algebraic thinking regarding measurement is manifested as arguments about comparisons through other symbols than numbers, arguments about how variables affect each other, and arguments about general relationships. Algebraic thinking regarding geometry was manifested by verbal explanations about numbers, values, operations, and, to denominate, classify and describe mathematical concepts.

Further research grounded in this literature review could be questions about for example what theoretical frameworks that are used when analysing algebraic thinking.

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