

ZMATH 2014a.00686

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Prospective mathematics teachers' sense making of polynomial multiplication and factorization modeled with algebra tiles.

J. Math. Teach. Educ. 16, No. 5, 349-378 (2013).

Summary: This study is about prospective secondary mathematics teachers' understanding and sense making of representational quantities generated by algebra tiles, the quantitative units (linear vs. areal) inherent in the nature of these quantities, and the quantitative addition and multiplication operations – referent preserving versus referent transforming compositions – acting on these quantities. Although multiplicative structures can be modeled by additive structures, they have their own characteristics inherent in their nature. I situate my analysis within a framework of unit coordination with different levels of units supported by a theory of quantitative reasoning and theorems-in-action. Data consist of videotaped qualitative interviews during which prospective mathematics teachers were asked problems on multiplication and factorization of polynomial expressions in x and y . I generated a thematic analysis by undertaking a retrospective analysis, using constant comparison methodology. There was a pattern which showed itself in all my findings. Two student-teachers constantly relied on an additive interpretation of the context, whereas three others were able to distinguish between and when to rely on an additive or a multiplicative interpretation of the context. My results indicate that the identification and coordination of the representational quantities and their units at different categories (multiplicative, additive, pseudo-multiplicative) are critical aspects of quantitative reasoning and need to be emphasized in the teaching-learning process. Moreover, representational Cartesian products-in-action at two different levels, indicators of multiplicative thinking, were available to two research participants only.

Classification: H49 H39

Keywords: additive reasoning; algebra tiles; Cartesian product; concept-in-action; mapping structure; models and modeling; multiplicative reasoning; polynomial rectangle; prospective teacher education; quantitative reasoning; relation; representation; bijections; polynomial multiplication; polynomial factorization
doi:10.1007/s10857-013-9237-4