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MS-Math – A design research project to support university students’ fostering-competencies and primary school students’ learning with the focus on perceiving, understanding, and using patterns and structures

Laura Korten

University of Muenster, Germany; laura.korten@uni-muenster.de

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Introduction

The poster presents the German project “MS-Math – Muster und Strukturen der Mathematik wahrnehmen, verstehen und nutzen lernen” (‘Learning to perceive, understand and use patterns and structures in mathematics’). In this design research project, a support-program will be iteratively designed and implemented at the University of Muenster. It aims to provide diagnosis-guided support for primary school students with difficulties in learning mathematics. The support will be planned, realised and reflected by university students (student teachers). By doing this the university students will be stimulated to develop and improve their fostering-competencies at the same time.

Design and research interest

As the full name of the MS-Math project (see above) implies, the support-program focuses on patterns and structures in mathematics. For the area of arithmetic, this means that children get specifically supported in perceiving, understanding, and using number and problem relations for flexible calculation. Regarding this, a differentiation between ‘inter-modal’ problem relations (between problems) and ‘intra-modal’ problem relations (within problems) is defined in the project. MS-Math pursues the following three goals, which also reflect the design and research interest:

(1) Practice-oriented research – Gaining new research insights: In the project, in-depth insights of arithmetical learning processes of the supported children as well as of the supporting students regarding their fostering-competencies will be gained. The analysis of the learning processes and learning outcomes on both levels will contribute to a research-based specification of a fostering concept for primary school students with difficulties in learning mathematics. This concept has its focus on perceiving, understanding, and using arithmetical patterns and structures. The project also contributes to a deeper understanding about university students’ development of fostering-competencies.

(2) Research-based design – Developing a university support-program in a research-based and practice-oriented manner: The university students are given the opportunity to develop and deepen fostering-competencies regarding support-oriented diagnosis & diagnosis-guided support in a case-based manner. The analysis of the learning processes and outcomes of the supported children and of the supporting university students (see (1)) will allow a research-based development and an empirical assessment of the support-program as a meaningful and rich learning environment for both, university students and primary school children.

(3) Research-based cooperation – Supporting teaching and learning at schools in Muenster: Teachers receive support in fostering children with difficulties in learning. The participating children receive weekly support based on their individual competencies and on latest research findings.

Theoretical background and design research methodology

Regarding primary school students' learning processes, with its outlined focus on perceiving, understanding, and using arithmetical patterns and structures, the project is following promising research findings (e.g. by Rechtsteiner-Merz & Rathgeb-Schnierer 2016; Verschaffel et al., 2009; Mulligan & Mitchelmore, 2013). On this basis the support gets planned, realized, and analysed. Regarding university student' fostering-competencies the approach of „professional noticing of children's mathematical thinking“ by Jacobs et al. (2010, p.172f.) is leading, to conceptualize three aspects: 1) attending to children's strategies, 2) interpreting children's understandings and 3) deciding to respond on the basis of children's understanding (ebd., p.172ff.).

Following a design research approach, a support-program as a meaningful and rich learning environment for university and primary school students will be designed, tested, and improved by conducting design experiments in iterative design research cycles (Prediger et al., 2015). Each design experiment – a support session of two supporting university students and one supported child – gets video recorded. Their learning processes will be analysed using interpretative tools, which allow to gain new research insights (see (1)) and a research-based development of the support-program (see (2)).

First results: University students need specific criteria to be able to attend to children's arithmetical strategies. Two criteria could be derived so far: Criterion of 'informativeness' and 'process reference'. The awareness and reflection of 'macro and micro cycles of diagnosis and support' helps them to respond more and more adaptively on the basis of children's arithmetical understanding.

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