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## ► To cite this version:

Louise Meier Carlsen. A study of the development of mathematics student teachers' knowledge on the implementation of CAS in the teaching of mathematics -a praxeological analysis.. CERME 10, Feb 2017, Dublin, Ireland. hal-01942114

**HAL Id: hal-01942114**

**<https://hal.science/hal-01942114v1>**

Submitted on 2 Dec 2018

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# **A study of the development of mathematics student teachers' knowledge on the implementation of CAS in the teaching of mathematics -a praxeological analysis.**

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*Keywords: CAS, student teacher knowledge, praxeology, lesson study.*

## **Introduction**

The implementation of CAS in the teaching of mathematics introduces new challenges that concern: content, technology and didactics. There is a change in the mathematical focus from pragmatic to more epistemic, since the routine work is taken over by digital tools (Artigue, 2002). Furthermore the didactic changes, not only by the change in the mathematical knowledge, but also due to the need for the teacher to orchestrate a new component in the classroom (Drijvers, Doorman, Boon, Reed, & Gravemeijer, 2010). In the course “Numbers, Arithmetic and Algebra” for mathematic student teachers for lower secondary school on the Faroe Islands we implement the format of lesson study as a tool for the student teachers to develop their knowledge on teaching with CAS. This is a preliminary study of the transcripts from a reflection meeting, which will later form the basis for a more detailed study as part of my work towards the PhD.

## **Theoretical framework and research question**

The anthropological theory of the didactic (ATD) suggests considering human activity as an amalgam of praxis and knowledge: praxeology. The praxis, also named the praxis block of the praxeology, consists of the constituting task and the corresponding technique. A technique can consist of several actions. The task and technique are in one-to-one correspondence. The knowledge, also called the logos block, is the discourse of the techniques and the theory that explains and verify the discourse. For more details see (Bosch & Gascón, 2014). This study considers the didactical praxeology and the mathematical praxeology of mathematics student teachers when implementing CAS in research lessons. Within ATD the task of solving an equation with CAS is categorized as mathematical praxeology, while the task how to teach the students to solve an equation using CAS is categorized as a didactic praxeology. The research question is “What didactical logos developed during the reflective meeting of a lesson study cycle?”

## **Context and study**

The study is situated within a course focused on numbers, arithmetic and algebra. As part of the course, groups of three to four students participate in four lesson studies where CAS has to be implemented in the teaching of algebra in grade 7 and 8 (14 - 15 year). Each lesson study cycle consists of a planning phase resulting in a lesson plan, a research lesson, a reflection meeting and a new lesson plan. In the lesson plans, the student teachers will not only describe the intended lesson but also have to justify the instrumental orchestration, part of the didactical technique, in relation to the mathematical praxeology of the lesson. Reflection meetings in lesson studies are a rich environment for the development of knowledge for teaching (Miyakawa & Winsløw, 2013;

Rasmussen, 2015). As part of the protocol for these meetings, the student teachers reflect on the relationships between the instrumental orchestrations used during the research lesson, the development of the mathematical praxeology of the students and the mathematical praxeology of the teacher.

## Conclusion

As an example, the mathematical praxeology of making two integer sliders in GeoGebra and the related didactical praxeology of how to teach students to make two integer sliders in GeoGebra is considered. As a didactical technique, the student teachers chose to hand out a booklet with step-by-step instructions in order to guide the students through the lengthy technique. Focusing on the didactical logos related to the technique of handing out a booklet during the reflection meeting the teacher students concluded that if the student did not get the exact same picture as in the booklet such as slider  $b$  above slider  $a$  instead of slider  $a$  above slider  $b$ , they would consider it an error and not usable. Additionally, the students were discouraged by having to read text in addition to carrying out the GeoGebra technique. It was agreed upon by the student teachers that a booklet is still a good didactical technique but has to be complemented or preceded by a board-demonstration for the students.

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