

# PROFESSIONAL COMPUTER ALGEBRA SYSTEMS IN UPPER SECONDARY MATHEMATICS

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*We address the issue of use of professional computer algebra systems (CASs) in upper secondary mathematics as opposed to CASs that are designed with school educational purposes more explicitly in mind. We propose a didactical engineering project in which the epistemological analysis of CAS use sets out, through the dictum of C's: Assets of CAS are conceptual, computational and communicative, from the dialectics between CAS as an enhancement of mathematical modelling power and CAS as a virtual reality which itself needs to be modelled and interpreted by mathematics. Design, a priori and a posteriori analysis will be based in part on the theory of instrumental genesis and orchestration (Trouche, Drijvers) in part on ATD (Chevallard). Special emphasis will be given to the secondary-tertiary transition.*

## SECTIONS OF THE POSTER

The poster will be composed of

### Illustrative Maple worksheets

Some sheets demonstrating the potentials and pitfalls of the use of CAS with professional power, such as

- A sheet demonstrating how excessive computational power may lead to shallow understanding and therefore deceptive instrumental genesis.
- A sheet exploring real numbers as (infinite) decimal expansions by exploiting CAS computational power subject to a dogma principle (arithmetic first principles).
- A sheet exploring continuity and fix points by exploiting the power of CAS visualization.

### Outline of the epistemology of the impact of CAS use on mathematical content and routines

Vertices in the epistemological coverage will be

- Use towards authentic problems may lead to command of mathematics reducing to ability to choose appropriate CAS applications.
- Taxonomic nivellement of classical routines (i.e. **solve(f(x,y),x)** vs. **solve(f(x,y),y)**).
- Development of mathematical praxis with focus on mathematical core issues.

The epistemology will involve praxeological analysis in the sense of ATD (Chevallard, 1999) as well as mathematical content and concept analysis. For

instance, the announced Maple sheet on decimal expansions can be described as a point praxeology involving direct CAS calls of decimal expansions encompassed by a local praxeology where the dogma condition, arithmetic first principles, determines the local praxeology technology as well as (part of) the point praxeology theory. How various incarnations of the full CAS program influence the scope of mathematical content and didactics will be a key issue.

### **Outline of implementation of designs in Danish secondary mathematics education through an action research framework for teachers.**

This section will primarily be based on the theory of instrumental genesis and orchestration and a model description of a reflective practitioner community.

### **Outline of further steps in an a posteriori analysis**

This section involves analysis of praxeologies (Chevallard, 1999) in the internal institutional setting of the classroom and the institutional setting determined by official regulations - including the didactical transposition in the transitions to higher education.

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