

DEPARTMENT OF MATHEMATICAL SCIENCES



# Out- and insourcing, an analysis model for use of instrumented techniques



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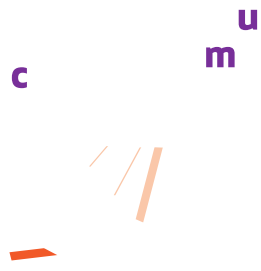
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# The scene and the problem

# Local progression ↔ global regression

(OECD 2015) The results also show no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education ...

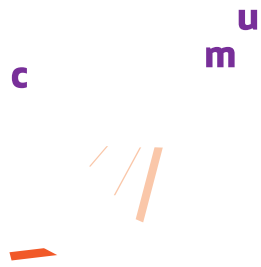
(Ruthven, 2009) What is agreed on both sides (of the debate), however, is that while innovations set out to change schooling, a reciprocal process unfolds in which schooling changes innovations.



# ICT:= CAS(like) tools

- Computer Algebra Systems
- Dynamic Geometry Systems
- Spread sheets
- ...
  - Unequivocally mathematical
  - Transform the discipline





# The problem

- Why has the CAS potential not come off on a larger scale?
  - Does good practice ‘scale up’?

Most of the reported practices are developed on definite didactic models and performed with dedication.

- What are the motivations/rationale for decisions of the ordinary teacher on employment of digital techniques?
  - Standards for use?
  - Opinion and beliefs
  - Technological pedagogical content knowledge (TPACK)
  - ...
- What do teachers actually do?

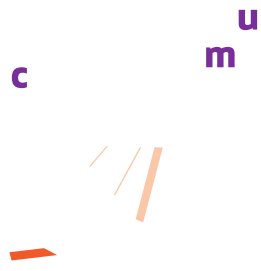


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**Out- an insourcing  
w.r.t. praxeologies**



# ATD framing (Y. Chevallard)

- Teachers are **directors** of didactical processes
- Activities described in terms of **praxeologies**
- Educational objectives: **Didactical transpositions** of scholarly knowledge
- Didactical processes aim at establishing meaningful **relations between students and (mathematical) bodies** of knowledge and performance within institutions.
- **Institutions** are defined to be a collection of people who share a system of praxeologies that are interrelated (i.e. teacher and class with a learning agenda)



# Core competency of an institution

is performance of a task characterized by belonging to a praxeology giving **better learning outcomes** than other (competing) praxeologies (perhaps in other institutions)

‘Better’ relates to

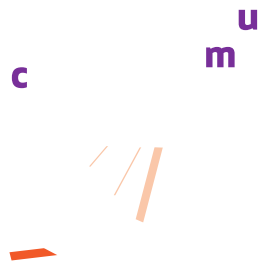
- **educational objectives** of a specific didactical transposition at a specific level of didactical co-determination.

The notion is general, but here focus on

- praxeologies based on **instrumented techniques** (Artique, 2002),
  - i.e. in terms of **pragmatic/epistemic values**.
- ...







# Allocation of sources

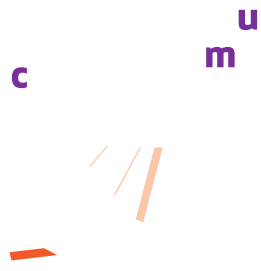
A *didactical corporation* is an institution where the praxelologies aim at educational objectives. It *produces learning outcome*. The teacher is the *director* and makes *decisions on source allocation* in order to *optimize production*

*Outsourcing* means performing tasks with techniques from an external provider. The essence of 'external' is **relaxation of** (or giving up on) **control**.

*Insourcing* means internal sources, i.e. sourcing of production of learning outcome through praxeologies **with control**.

*Backsourcing* means reallocation of sources from external to internal, for instance in order to regain control.





# Praxeologies for arithmetic

## Paper and pencil arithmetic

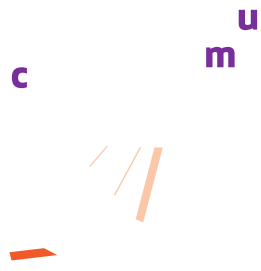
- (Multiplication) algorithm involving mental computation/multiplication tables
- Systematics and rationale of algorithms.
- Theory of the integral domain  $\mathbb{D}$ .

## Calculator computation

- Entering of numbers, call of arithmetic operators.
- Manual of calculator. Rules for number of decimals. ...
- Representation in finite register. Interpretation of display.

**Key difference: Control of task outcome**





# Examples of out- & insourcing

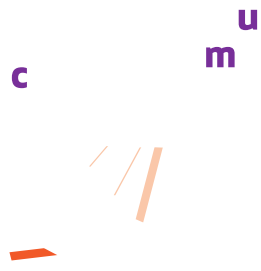
## Non-instrumented outsourcing

- Use of techniques utilizing formulae that have not been deduced within the institution.
- Criteria for extremal values
- Descartes' rules for number of zeros
- Rôle learning, sometimes, but not always, with subsequent backsourcing.
- Learning by domain restriction (advanced fractions, based on number fractions)
- Calculus techniques in High School

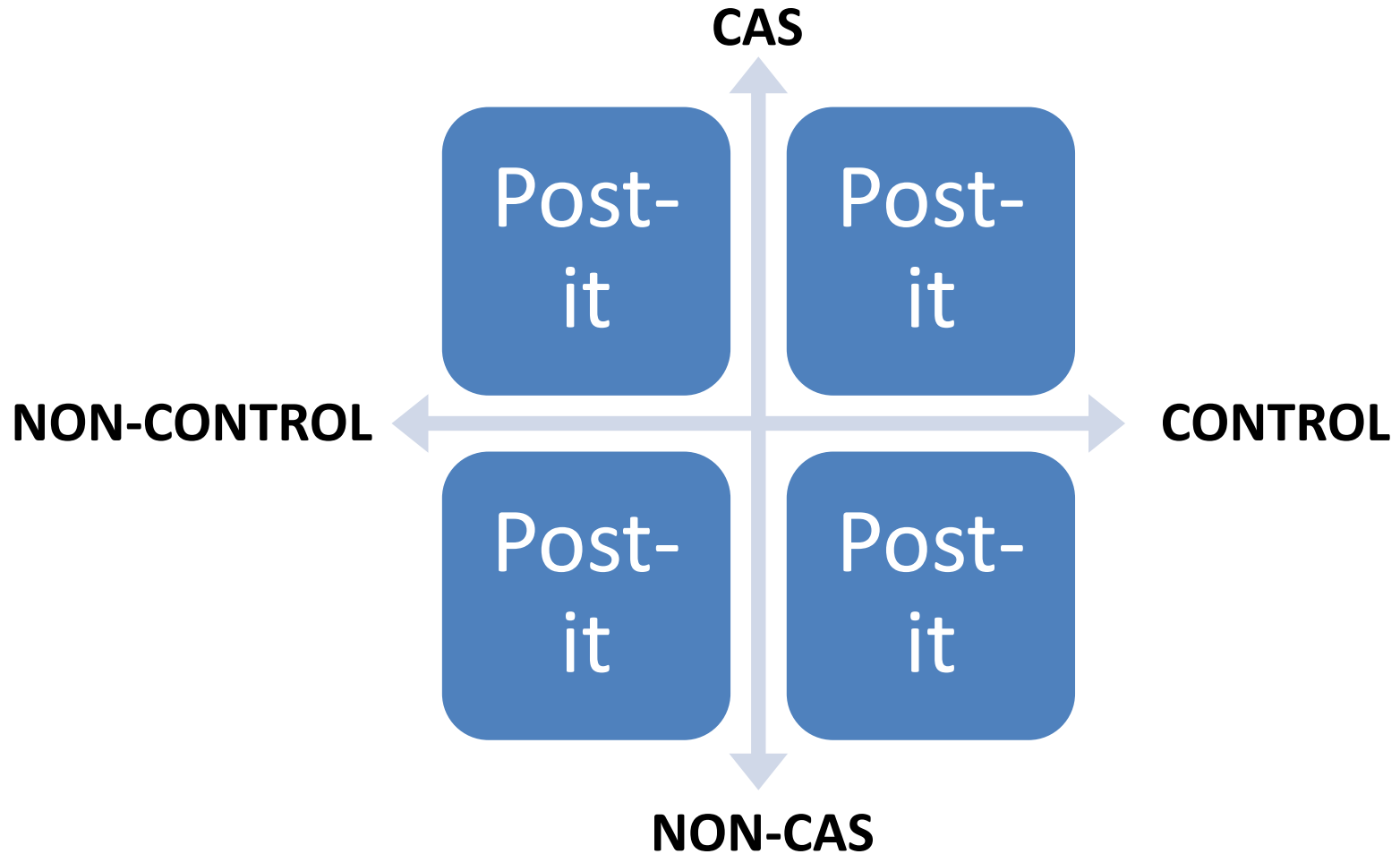
## Insourced instrumental techniques

- Plotting of well-known classes of functions (i.e. linear)
- Simple Excel-diagrams from manageable data sets.
- ...

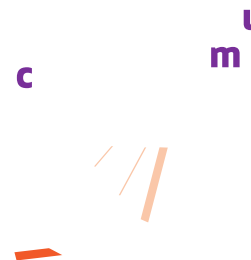




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