# RE(S)SOURCES 2018

*Reflecting on a theoretical approach from a networking perspective: the case of the documentational approach to didactics*

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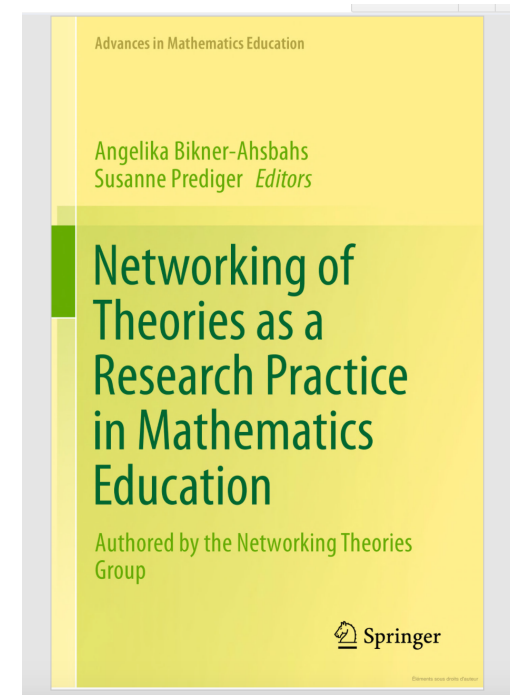
# Outline

- Introduction to the networking of theoretical approaches, and to some basic tools of it.

- Use of the networking perspective to reflect on the development of the DAD.

- Towards new and promising connections: DAD and the Lexicon international project.
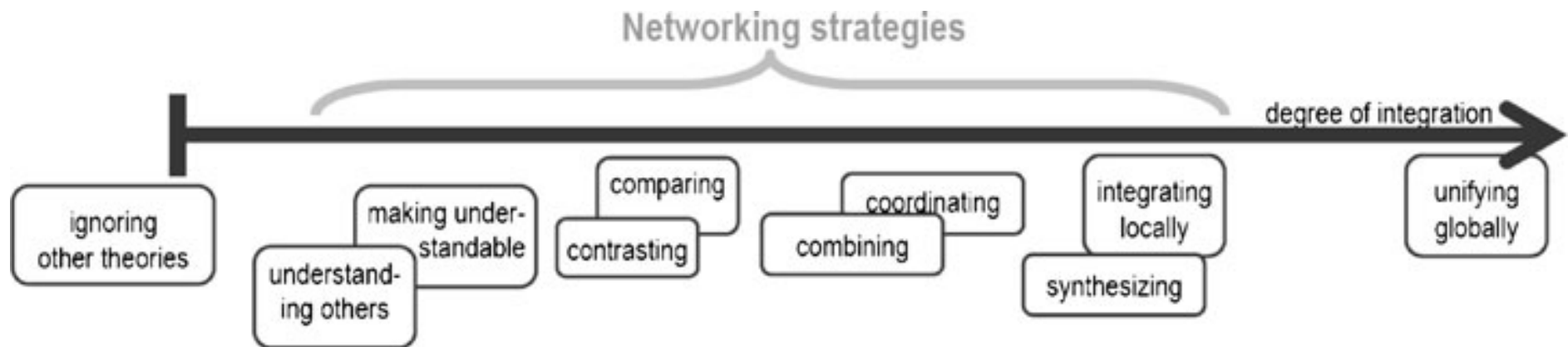
# Introduction to the networking of theories

- Increasing international awareness that the issues raised by theoretical diversity were insufficiently addressed at the global level of the Math Education Community, inducing theoretical fragmentation.
- Different incentives at the European level:
  - European projects such as the ERT TELMA within the NoE Kaleidoscope (2003-2005), and then the project ReMath (2005-2009).
  - The creation of a specific CERME group on theoretical approaches and their comparison at CERME 2005.
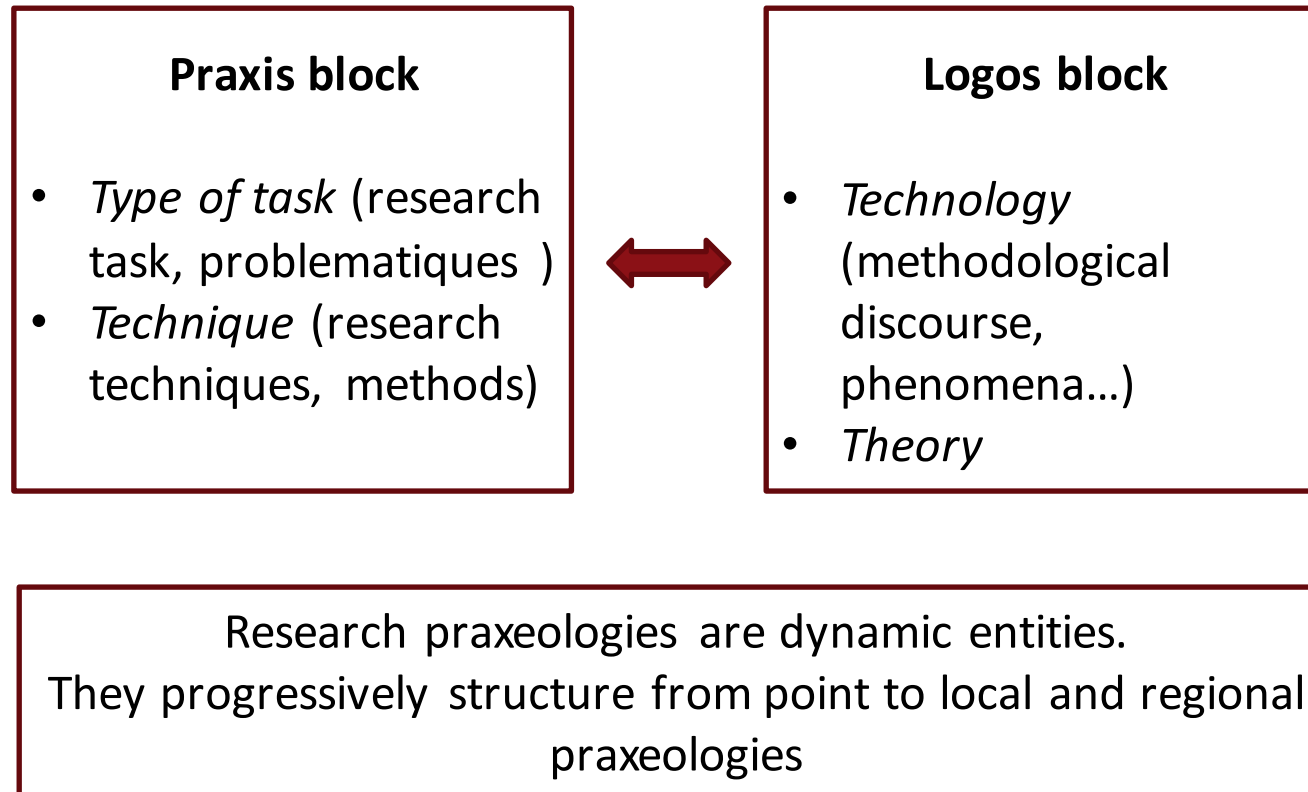  - The emergence of the 'Bremen Group' at CERME 2005.

# The networking scale
(Prediger, Bikner-Ahsbahs & Arzarello, 2008)

# The concept of research praxeology

**Praxis block**

- *Type of task* (research task, problematiques )
- *Technique* (research techniques, methods)

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**Logos block**

- *Technology* (methodological discourse, phenomena...)
- *Theory*

Research praxeologies are dynamic entities.
They progressively structure from point to local and regional praxeologies

# How the networking perspective has shaped my enquiry

- Paying attention to the diversity of possible forms of establishing connections between theoretical approaches and constructs.

- Analyzing connections considering research praxeologies as a whole, and not just their theoretical component, and the different conditions and constraints shaping these.

- Envisaging the development of connections as bi-directional.

# The emergence of the DA(D)

The coherent evolution of research praxeologies regarding digital technologies:
from CAS to spreadsheets, DGS, and online bases of exercises;
from a focus on students to a focus on teachers.

The collective design of resources (SFODEM)

A new *problematique*: Capturing the important changes brought by digital resources in the documentational work of secondary math teachers, this work being seen as an essential and under-researched component of their practice.

# The emergence of the DA(D)

A clear theoretical continuity

Rabardel's instrumental approach and its use in math education → An instrumental approach of the teachers' documentational work

A new methodology: *Reflective investigation* framed by four principles

# First results

- Evidencing the complexity of teachers' systems of resources, and the role played beyond material resources by interactions with other agents (students, colleagues).

- Evidencing the substantial changes induced by technological evolution.

- Evidencing the teacher agency and authorship at stake in documentational geneses, blurring the fronteer between resource designers and users.

- Evidencing that documentational activity is both *productive* and *constructive,* and opens a unique window on teacher professional development.

# What about theoretical connections at this stage?

- A first important connection with Adler's research work and conceptualization of resources as anything with potential for re-sourcing teachers' activity:

  – *Resources for school mathematics extend beyond basic material and human resources to include a range of other human and material resources, as well as mathematical, cultural and social-resources. (Adler, 2000, p.210)*

- A conceptualization directly influencing the definition of resource in DAD, and impacting in return the methodology of reflective investigation.

# What about theoretical connections? (Gueudet & Trouche, 2010)

- Various authors mentioned in the two chapters co-authored by Gueudet and Trouche, and links to other chapters but few connections really worked out, which could be expected.

- In Chapter 3, however, one example of combination: connecting systems of documents and systems of activities whose 9 categories are directly inspired by the Study moments of ATD (p. 70).

- In Chapter 10, the explicit connection with CoP and the use of associated criteria (Wenger 1998).

# What about theoretical connections? (Gueudet & Trouche, 2010)

- In other chapters, again many cross-references, but few advanced forms of networking.
- Making understandable other approaches (most chapters).
- Comparing, contrasting.
- Coordinating.
- Locally integrating.

# Comparing, contrasting (Mariotti & Maracci)

- An evident theoretical proximity: Rabardel's instrumental approach and the Vygostkian perspective underlying the Theory of semiotic mediation.

- However, an evident distance between research praxeologies: the interest is in how teachers make a technological artefact an instrument of semiotic mediation for students, especially through the orchestration of classroom discussions, not in teachers' documentational geneses.

- A distance, which is pointed out by the authors.

# Comparing, contrasting (Vandebrouck)

- An evident theoretical proximity: The theory of activity and cognitive ergonomics are at the basis of both the Dual didactic and ergonomic approach to teaching practices (Robert & Rogalski) and Rabardel's Instrumental approach.

- However, a clear distance between research problematiques, research methods and conceptual tools; the methodological focus on the analysis of the couples (tasks, 'déroulement').

- The hypothesis made  that evolutions of these couples interpreted in terms of stability and evolution of the five components of the Double approach could allow to characterize documentational geneses.

# Locally integrating (Traglova)

- Combining DA with Margolinas' model of teacher activity and Balacheff 's cKc model of conceptions, to analyse teachers' didactic decisions.

- The experimental context (Lima's thesis): the design of a lesson about line symmetry with a given set of resources (students' productions and a set of 18 tasks).

- Two successive analyses of the data provided, the second with the DA, identifying elements of documentational geneses and associated emerging schemes, and a conclusion combining these analyses and their respective discourses.

- The facilitator role of the research methodology: simulating some form of documentational work.

# And then…

- A second book in English in 2012, an issue of ZDM in 2013, co-edited by Gueudet, Pepin and Trouche; a very well attended TSG at ICME-13 in 2016 and an associated book, research articles, doctoral theses..., showing:
  - The stability of the theoretical core of the DAD.
  - The consolidation of the methodology of reflective investigation with the associated SRRS tool, emblematic of DAD.
  - The sustained connection with Wenger's theory and the concept of CoP, fostered by the increasing attention paid to the collective work of teachers.
  - The diversification of research problematiques and contexts and the deepening of theoretical connections, together with the development of joint authorship.

# Theoretical crossing

Design-based Research

CoP

Remillard's approach

The dual didactic-ergonomic approach

CHAT

Fleck's theory

Webbing approaches

Information and Communication Sciences

Computer sciences

Constructionism

Theory of social creativity

Didactical meta-transposition

# Theoretical crossing (Gueudet & Vandebrouck 2011)

- From (Vandebrouck, 2010), a substantial evolution.
- The common theoretical background emphasized ('cousin' approaches).
- Distinct case studies to cope with the methodological distance, however common characteristics.
- A substantial part of the article devoted to the comparison of the two case studies and of the underlying approaches, clarifying similarities and differences according to particular dimensions, and identifying complementarities.

# The diversification of contexts (Pepin, Xu, Trouche & Wang, 2017)

- A problematique connecting documentational work and teaching expertise, certainly influenced by the context:
  - How do three Chinese 'expert' mathematics teachers describe their resource system, which kinds of resources do they use in/for their daily practice ?
  - How do the three case teachers perceive expertise in teaching mathematics, and how to develop such expertise?
  - What are the characteristics of the three teachers' resource systems, and in which ways they characterize mathematics teaching expertise?

- DAD as the theoretical framework, and a methodology inspired by reflective investigation.

# The diversification of contexts (Pepin, Xu, Trouche & Wang, 2017)

- Results:
  - A clear diversity of the three teachers' resource systems.
  - However, a common emphasis on the collective aspect of developing, and more importantly of sharing resources to improve instructional practices, and the role played by contextual factors in this sharing: TRGs (Teaching Research Groups), QQ discussion groups and public lessons.
  - The existence of a clear notion of mathematics teaching expertise in China, thus a clear professional identity, going with different perceptions of what expertise exactly means expressed by these three teachers.
- The conclusion that the lens of resources provides an useful tool for examining mathematics teaching expertise, making it possible to bring to the surface different aspects of this expertise.

# Language issue

« After transcribing (in Chinese) and translating (in English) the interviews, we realized that our reflections on translations were actually reflections on the theoretical choices made. In order to enhance the conceptual equivalence of notions when translating (e.g. Hantrais & Mangen, 1996), several steps were taken […] We contend that the translation of Chinese texts into English needed delicate work of negotiation and comparing understandings, leading to a deeper understanding of the main concepts at stake (e.g. 'resources', 'collective work') »
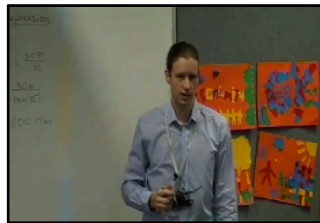
# The Lexicon Project (http://www.lexicon.iccr.edu.au)



- A comparative project leaded by David Clarke and Carmel Mesiti, and involving now 10 countries.
- Rationale:
  - The crucial role of language in what we are able to perceive and express, and the limitation to expression and sharing induced by the use of English as lingua franca for international communication.
  - The under-developed state of mathematics teachers' professional discourse in most countries, contributing to maintain the profession in a state of semi-profession.
- Goal: To document and compare the naming systems 'reasonably shared' by mathematics teacher communities in the countries involved in the project to describe the objects and events in their classrooms, in order to expand on the variety of constructs available for the purpose of theorizing about classroom practice, and of identifying accomplished practice (Mesiti et al., 2016).

# The global methodology

1. Constitution of mixed teams of teachers and researchers in each country.

2. Production of a set of videos in grade 8 mathematics classrooms taught by experienced teachers (one per country).

3. Use of the videos as a stimulus, to build a provisional lexicon for each country, giving predominant voice to teachers.
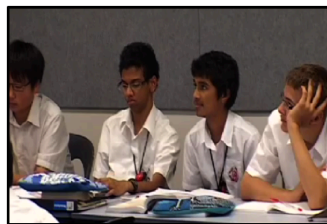
# The stimulus package

The lexicon stimulus package includes different resources: lesson videos, time-stamped transcripts in original language and English, and support material from participating countries.


Teacher Camera


Whole Class Camera


Focus Group Camera


Transcript (in English)



T "The angle of depression is when, is the angle from something up high, how, what is the angle that you look down to see that object."

00:09:36:09

# The global methodology

4. Multi-step review/revision process of each provisional lexicon in the country, followed by a cross-quality check between Lexicon partners after 'translation' into English, leading to the current 'finalized' version to be made public.

5. Development of comparative studies with specific methodologies depending on the questions at stake.

# A successful project but…

- Just a first step if one considers that the teachers' professional activity is not limited to what happens in the classroom, and that the current versions of the lexicons mainly capture the didactical-pedagogical lexicons used in the description of the life of mathematics classrooms.

- Thus the interest of an extension of this project, investigating the terms used by teachers from different countries to describe their systems of resources and the use they made of these.

- The Friday workshop, co-organized with Luc Trouche, Maryna Rafalska, Ulises Salinas, Karima Sayah, Hendrik van Steenbrugge and Chongyang Wang, and involving researchers from 8 different countries and languages, starts the move in that direction, and a new and promising form of networking between research enterprises and communities.

# Thank you for your attention !