

# RE(S)SOURCES 2018 INTERNATIONAL CONFERENCE

UNDERSTANDING TEACHERS' WORK THROUGH  
THEIR INTERACTIONS WITH RESOURCES FOR TEACHING

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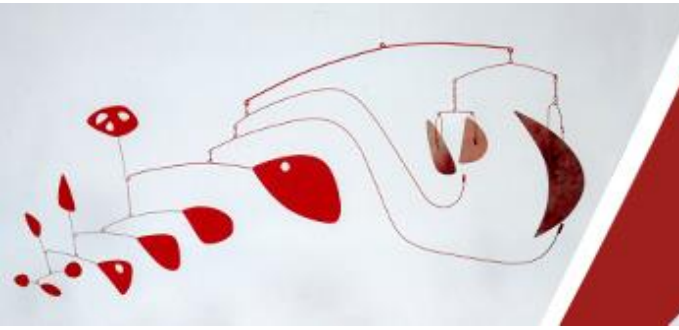
## **Studying Teachers' documentation work: emergence of a theoretical approach**

Ghislaine Gueudet

CREAD, ESPE de Bretagne, UBO

# Steps in a short history

1. From previous works to first propositions (-2007)
2. Theoretical and methodological developments (2008-2010)
3. Extension of the scope, new contributions (2011-2013)
4. Ways forward, 2014 and after



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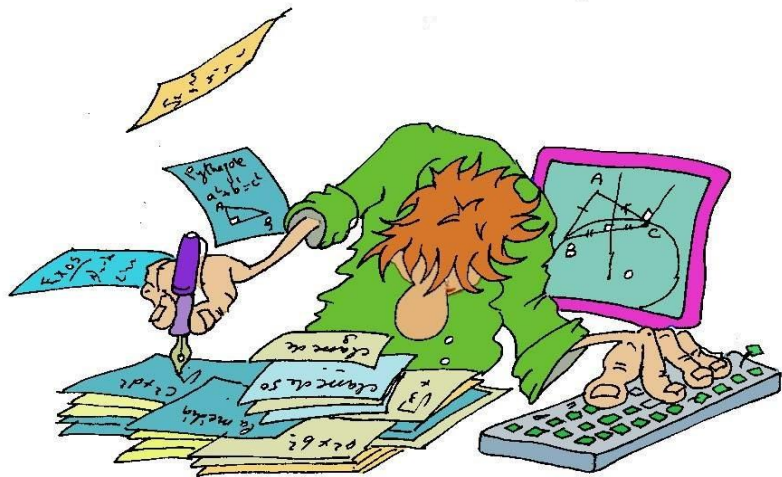
## **From previous works to first propositions**

( - 2007)

*In a context of increasing availability  
of online resources*

# Vers de nouveaux systèmes documentaires pour les professeurs de mathématiques ?

*Towards new documentation systems for mathematics teachers?*



Ghislaine Gueudet

CREAD et IUFM de Bretagne

Luc Trouche

LEPS (Lyon 1) et EducTice (INRP)

14ème école d'été de didactique des mathématiques, Ste Livrade, août 2007  
Thème 2 : situations mathématiques et documents pour le professeur

# Previous works, Luc Trouche

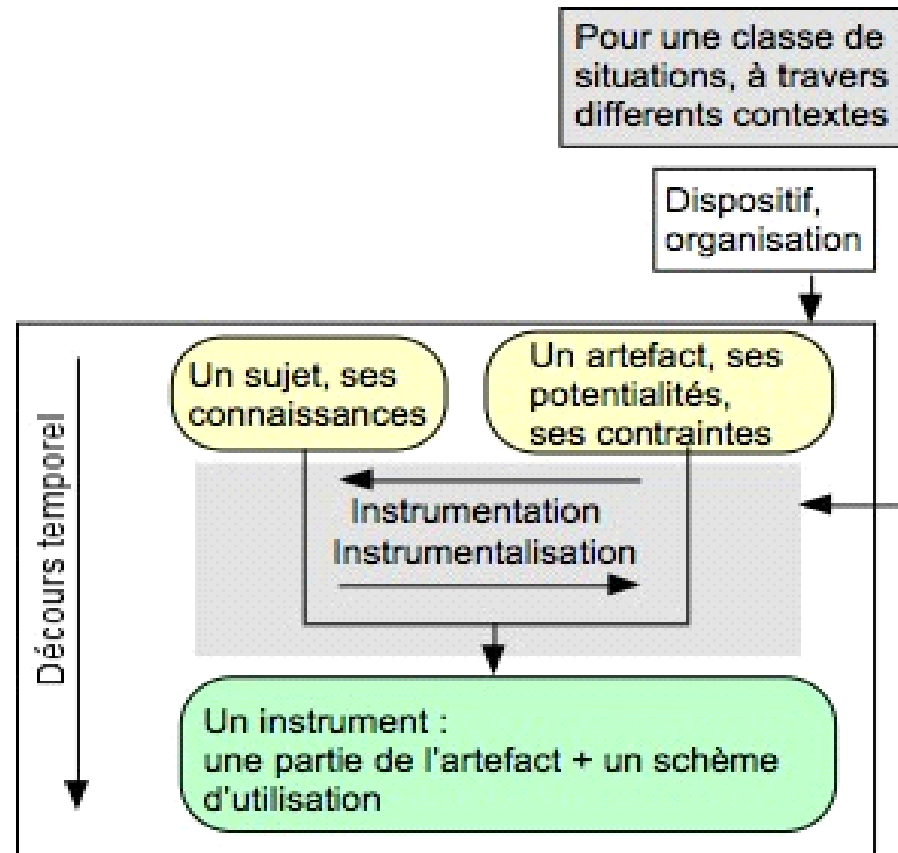
- Contribution to the development of the instrumental approach in mathematics didactics (Guin, Ruthven & Trouche 2005)
- Work on the collective design of resources, the case of the SFODEM (Guin & Trouche 2007)
- Building links between different fields (Baron, Guin & Trouche 2007): didactics, ergonomics, documentation engineering

# Previous works, Ghislaine Gueudet

- Studying students' work with online exercises (Cazes, Gueudet, Hersant & Vandebrouck, 2006). New kinds of resources, use of the instrumental approach.
- Studying teachers' work with online exercises (Bueno-Ravel & Gueudet, 2007). Use of the instrumental approach (teachers' instrumental geneses), structuring features of the teachers' activity
- No experience of theoretical propositions or networking...

# The instrumental approach

- The distinction between an artefact (a product of the human activity, designed for a goal-directed human activity) and an instrument developed by a given subject (Rabardel 1995)
- Instrument = artefact + scheme of use ; Instrumental genesis
- Scheme: aim of the activity; rules of action; operational invariants; inferences (Vergnaud 1996)
- The instrumentation / instrumentalization processes



# The instrumental approach

- *A class of situations* of professional activity (Rabardel & Bourmaud 2003): A set of situations corresponding to the same aim of the activity.
- *An activity family* (Rabardel & Bourmaud 2003): A set of classes of situations corresponding to the same type of aim of the activity.
- *Design for use, design in use* (Folcher 2005)



# Documentation engineering (French tradition)

- Bachimont (2004) Multimedia documents, new meanings, indexing issues
- Crozat (2007) « The notion of resource is used as resource to design documents ... The document bears an intention depending of the context of use. »
- Pédauque (2006, 2007) The digital means lead to interpret use as re-writing. « The document is a contract between human beings ».

# Technologies, textbooks, curriculum material, communities

- Ruthven (2007): structuring features of the teacher's practice. working environment; resource system; activity format; curriculum script ("a loosely ordered model of relevant goals and actions which serves to guide [the teacher's] teaching of the topic" p.61); and time economy.
- Remillard (2005), about curriculum material « these tools, as products of sociocultural evolution, both shape and are shaped by human action through their affordances and constraints ».
- Wenger (1998): Communities of practice have a shared repertoire, outcome of the reification processes.

# Questions and methods

## (Gueudet & Trouche 2007)

Which concepts are needed to analyse the activity and professional development of secondary school mathematics teachers ?

Methods:

Interviews with 9 teachers

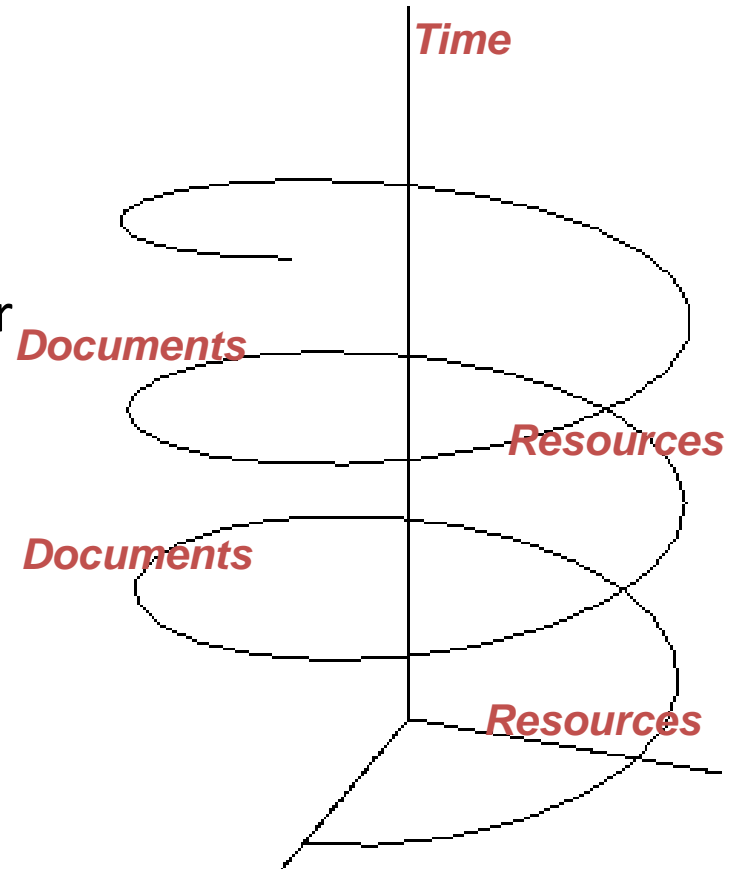


# Concepts introduced (solid) (Gueudet & Trouche 2007)

Solid findings (EMS Educational committee):

- are generally recognised as important contributions that have significantly influenced and/or may significantly influence the research field.
- can be applied to circumstances and/or domains beyond those involved in this particular research.

- Document = resources + schemes
- Documentational genesis, encompassing instrumentation and instrumentalization



# Concepts introduced (solid)

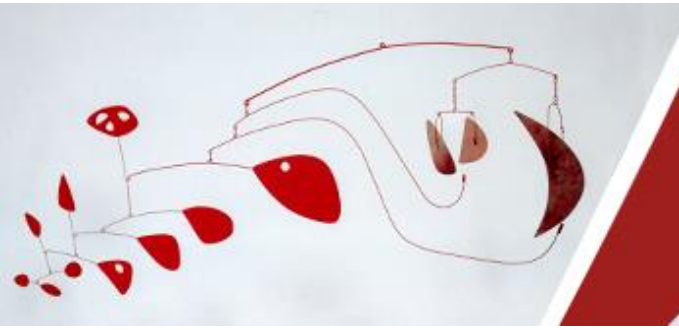
- Collective documentational geneses in communities
- *Documents systems*: the documents of a teacher are organized in a structured *documents (documentation, documentary) system*, according to the classes of situations and the activity families.
- *Resources systems*: A teacher also has a *Resource system*, which is the « resource part » of his/her documents system.

# Concepts introduced (not so solid?)

- *Three activity families of the teacher*: design and organise the teaching, participate to the school's organisation, reflect on his/her practice;
- *Pivotal documents*
  - Have a central place in the documents' system
  - Contribute to articulate other documents
  - Play a privileged role on the time axis. Concentrate the memory of previous resources, and intervene for the integration of new resources.
- *The compendium (le recueil)*: a central document, linking the other documents, playing a role of memory and of integration of new resources;

# Concepts introduced (not so solid?)

- *Three levels in a document*: material, mathematical content, elements for use in class;
- *The teacher's world* (ref. Béguin 2005): A *world* is a structure piloted by professional characteristics, offering a particular cutting of the reality.
- *The resources pool of a community* (vivier de ressources d'une communauté de pratique).



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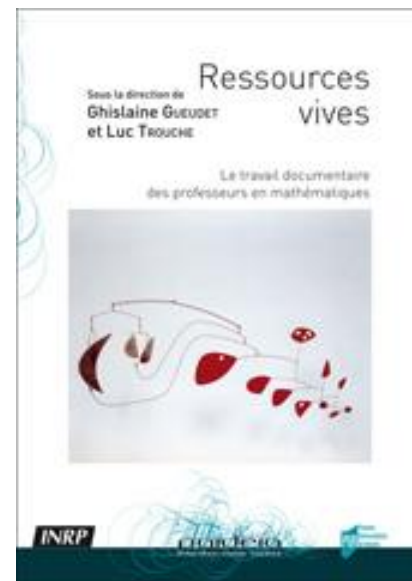
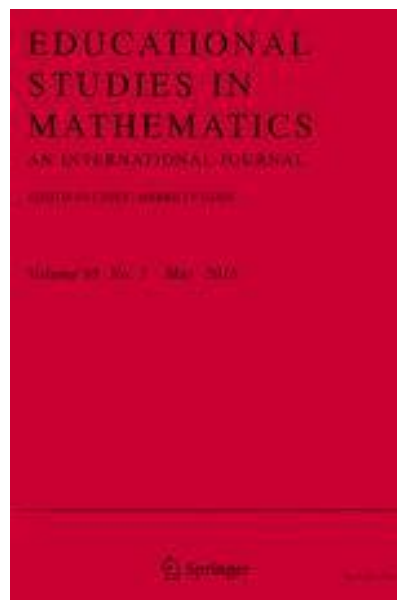
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## **Theoretical and methodological developments (2008 - 2010)**



# Three main references



2008 : Du travail documentaire des enseignants : Genèses, collectifs, communautés. le cas des mathématiques. *Education Et Didactique*, 2(3), 7-33.

2009: Towards new documentation systems for teachers? *Educational Studies in Mathematics*, 71(3), 199-218.

2010: Ressources vives, collective book in French. Chapter 3 and Chapter 7 about the documental approach.

# Evolution of the sources

## *A major step forward:*

Including the definition of resource by Jill Alder, and the associated perspective.

A focus on resources-in-use

“It is possible to think about resource as the verb re-source, to source again or differently” (Adler 2000, p. 205)

Different kinds of resources:

- Material
- Socio-cultural
- Human

# Evolution of the questions

- Which are the documents developed by secondary school mathematics teachers along their professional activity?
- How do the schemes of use of resources evolve, which are the operational invariants in such schemes?
- Which are the consequences for the documents developed by mathematics teachers of the generalized availability of digital resources?
- How are the resources systems and the documents systems of an individual teacher structured?
- How does the resources system of a community evolve, along individual and collective contributions?
- ...

# Evolution of the methods

## *Introduction of the reflective investigation method*


Principles:

- A long –term follow-up;
- The teacher is followed in class and out-of-class;
- The teacher is associated to the data collection in a reflective stance.

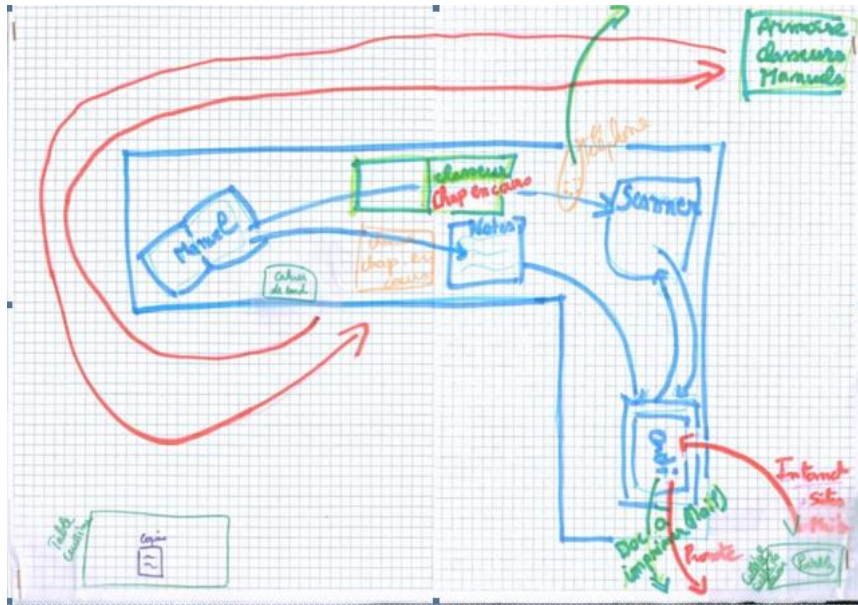
Data collected:

- Interviews, including Schematic Representation of the Resources System
- Resources used and produced
- Videos, including classroom videos
- Logbooks etc.

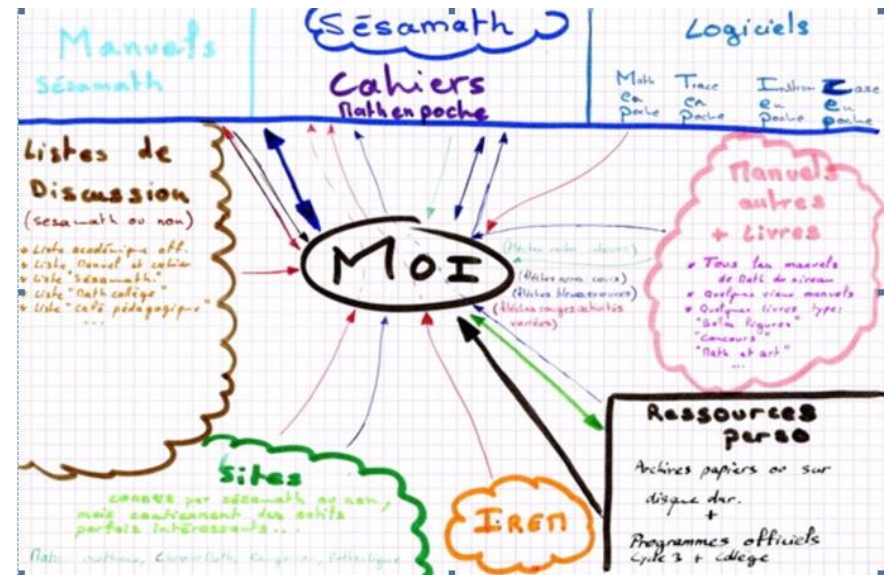
## Reflective investigation, a possible schedule

<p>First encounter:</p> <ul style="list-style-type: none"> <li>- presentation of the methodology, its spirit and its tools.</li> </ul>	<p>First visit:</p> <ul style="list-style-type: none"> <li>- about the resources in general;</li> <li>- about the chapter followed.</li> </ul>	<p>Second visit:</p> <ul style="list-style-type: none"> <li>- about the lesson observed.</li> </ul>	<p>Classroom observation</p>	<p>Third visit:</p> <ul style="list-style-type: none"> <li>- About the lesson observed;</li> <li>- Complements about the chapter and resources.</li> </ul>
<p>Tools:</p> <ul style="list-style-type: none"> <li>- Schedule;</li> <li>- Questionnaire;</li> <li>- Logbook.</li> </ul>	<p>Tools:</p> <ul style="list-style-type: none"> <li>- Interview guidelines;</li> <li>- SRRS</li> </ul>	<p>Tools:</p> <ul style="list-style-type: none"> <li>- Interview guidelines</li> </ul>	<p>Tools:</p> <ul style="list-style-type: none"> <li>- Observation guidelines</li> </ul>	<p>Tools:</p> <ul style="list-style-type: none"> <li>- Interview guidelines;</li> <li>- SRRS;</li> <li>- Collection of resources.</li> </ul>
<p>Week 1</p>		<p>Week 2</p>		<p>Week 3</p>
<p style="text-align: center;"><i>Filling the logbook</i></p> 				

## Evolution of the methods: SRRS



Corinne, experienced lower secondary school teacher



Pierre, lower secondary school teacher and member of Sesamath

Provides access to the content and structure of the resources system, as seen by the teacher.

A systematic analysis?

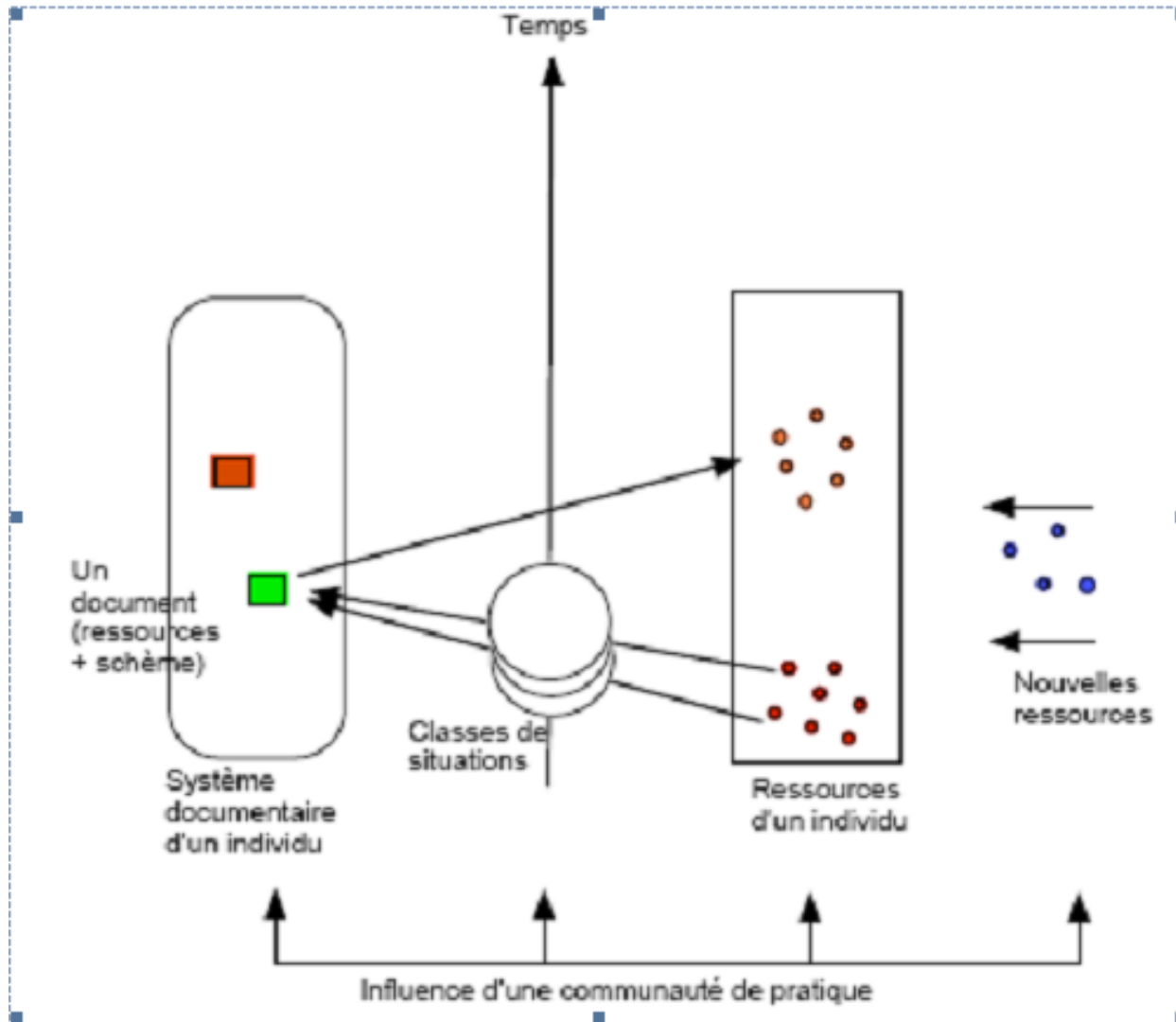
# Conceptual evolutions: structure of the documents system (still not solid)

Gueudet & Trouche (2010), 9 activity families

- Reflecting on his/her practice
- Planning
- Preparing and setting up introductory activities
- Preparing and setting up syntheses
- Preparing and setting up drill and practice
- Preparing and setting up assessment
- Manage the class and follow the students
- Participate to the school's life
- Participate to collective work out-of-class

No more pivotal documents, but: « *A set of pivotal resources, engaged in several activity families* ».

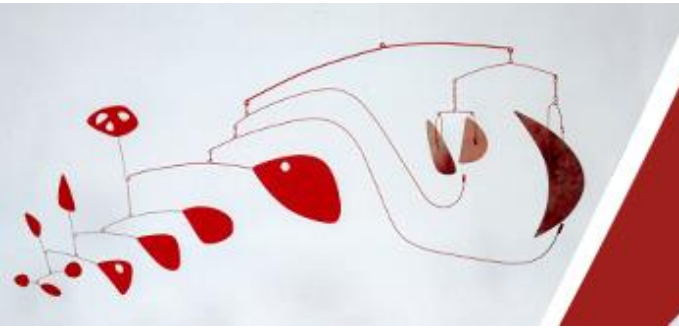
# Investigating links between individual and collective documentation work



A complex figure, representing four possible kinds of influences of a community on an individual's documentation work

(Gueudet & Trouche 2008)





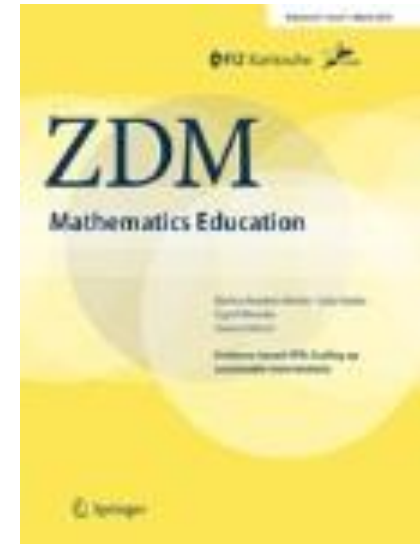
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**Extension of the scope, new contributions**  
(2011- 2013)

# A new determining international contribution...



Gueudet, G., Pepin, B., & Trouche, L. (Eds.) (2012). *From Textbooks to 'Lived' Resources: Mathematics Curriculum Materials and Teacher Documentation*. New York: Springer.

Pepin, B., Gueudet, G., & Trouche, L. (2013, Eds). Resourcing teacher work and interaction: new perspectives on resources design, use, and teacher collaboration. *ZDM, The International Journal on Mathematics Education, special issue 45 (7)*.

# Evolution of the issues studied

New investigations about particular resources:

- *Textbooks as resources*: interfaces between culture, policy and teacher curricular practice;
- *E-textbooks*: definition, classification

New links with task design, task analysis

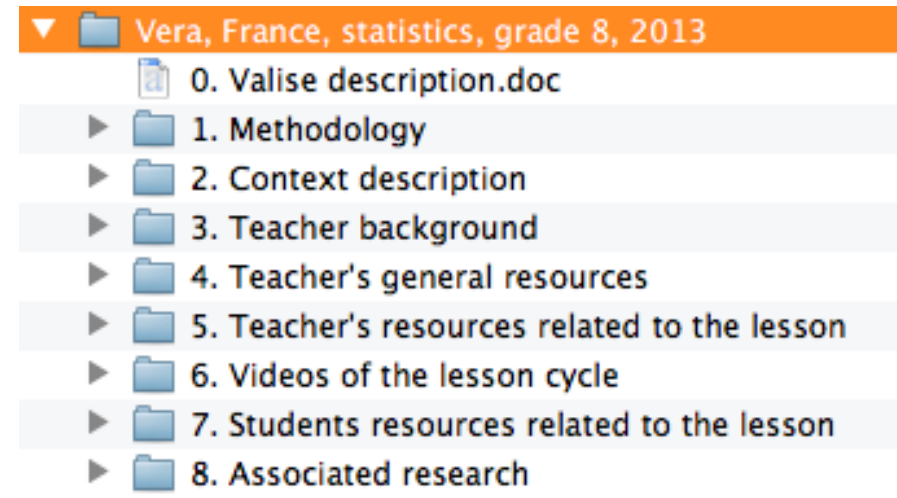
New focus on *teacher professional development programs*:

Designing teacher education programs, analyzing their design, their consequences in terms of teacher professional development, their use as resources by teacher educators...

# Methodological evolutions: the documentation valise

“The 'documentation valise' project relies on a metaphor: producing a teaching document is like a journey. In order to prepare for this journey, a teacher gathers resources, works on them, enriches them at each stage.”

Aim: shared case studies,  
international comparisons



# Methodological evolutions: the documentation valise



*Session 1*

*Preparation of the lesson. Exploring the resource system...*



*Session 2*

*Implementation of the resource, inputs of pupils, modification "on the fly"*



*Session 3*

*Debriefing after a class test. Pupils errors needing to rethink the initial resource*



*Session 4*

*Stimulated recall of the previous sessions...*

New data collected: video of preparation work (commented aloud)

# PhDs defended (director: Luc Trouche)

**2011, December 6 and December 7**

Gille Aldon, Interactions didactiques dans la classe de mathématiques en environnement numérique : construction et mise à l'épreuve d'un cadre d'analyse exploitant la notion d'incident .

Hussein Sabra, Contribution à l'étude du travail documentaire des enseignants de mathématiques : les incidents comme révélateurs des rapports entre documentations individuelle et communautaire



# Contributions of these early PhDs

- Introducing the notion of “documentational incident” (unplanned event ) and an associated method, focusing on incidents to analyse the individual or collective documentation work
- Developing the study of collective documentation work and associated methodological tools.

# Extension of the scope of DAD

New school levels:

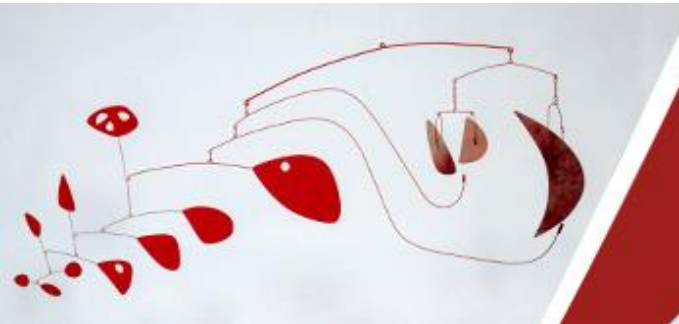
- Studies in mathematics at primary school and Kindergarten (Poisard, Bueno-Ravel & Gueudet 2011).
- Studies in mathematics at the university level (Gueudet, 2013)

Leading to questions on complex documents systems: for different disciplines, for teaching and for research...

Outside mathematics :

- In chemistry, PhD by Hammoud (2012) : « Ressources numériques et démarches d'investigation pour l'enseignement de la chimie »





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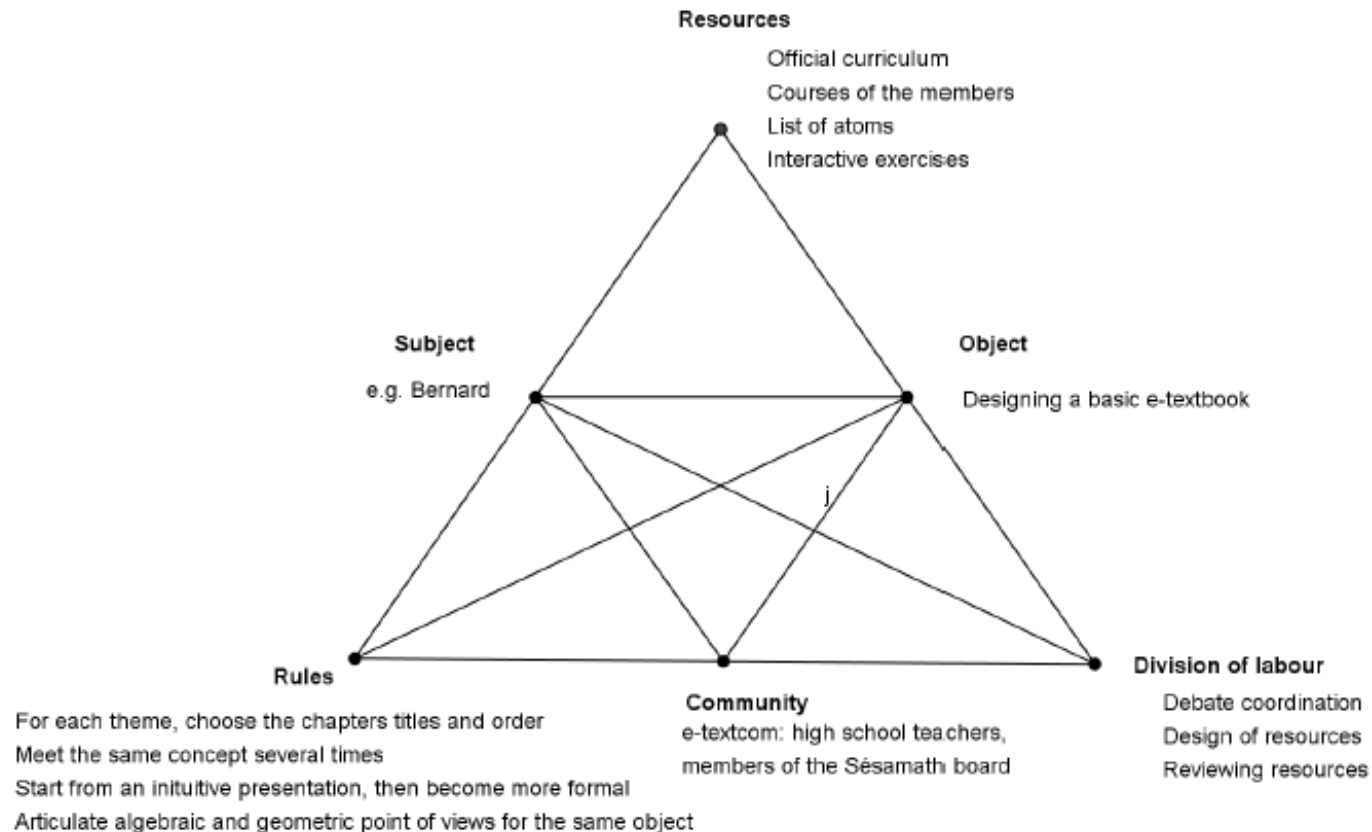
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## **Ways forward** (2014-)

# Theoretical articulations

Studying collective documentation work with Cultural-Historical Activity Theory (CHAT) (Gueudet, Pepin, Sabra & Trouche 2016)



# Theoretical articulations

- Linking documentational genes and design capacity (Pepin, Gueudet & Trouche 2017);

- Introducing the notion of connectivity for an e-textbook (Gueudet et al. 2018)

**Mathématiques 2de - Collection Barbazo - Version élève**

**Connaitre le cours**

### 4. Variations des fonctions et extrema

#### 1 Sens de variation

**Définition**  
On considère une fonction  $f$  définie sur un intervalle  $D$ .  
On dit que  $f$  est **croissante** sur  $D$  lorsque, pour tous réels  $a$  et  $b$  de  $D$  tels que  $a < b$ , on a  $f(a) < f(b)$ .  
On dit que  $f$  est **décroissante** sur  $D$  lorsque, pour tous réels  $a$  et  $b$  de  $D$  tels que  $a < b$ , on a  $f(a) > f(b)$ .

**Remarque** : cette notion est un attendu de fin d'année; la définition sera expliquée dans les chapitres concernant les fonctions.

**Exemples**  
- **Fonction  $f$  croissante**  
Pour tous réels  $a$  et  $b$  de  $D$ ,  $f(a)$  et  $f(b)$  sont rangés dans le même ordre que  $a$  et  $b$ .  
 $a < b \Rightarrow f(a) < f(b)$

- **Fonction  $g$  décroissante**  
Pour tous réels  $a$  et  $b$  de  $D$ ,  $g(a)$  et  $g(b)$  sont rangés dans l'ordre contraire de  $a$  et  $b$ .  
 $a < b \Rightarrow g(a) > g(b)$

#### 2 Tableau de variation

On illustre le sens de variation d'une fonction  $h$  dans un tableau, appelé **tableau de variation**.

On étudie les variations d'une fonction, c'est chercher sur quel(s) intervalle(s) elle est croissante ou décroissante. On résume ces résultats dans le tableau de variation de la fonction.

x	-1	1	2
Variation de h	↘	↗	↘

Ce tableau indique que :  
- la fonction  $h$  est décroissante sur  $[-1; 1]$ ;  
- la fonction  $h$  est croissante sur  $[1; 2]$ .

#### 3 Maximum et minimum d'une fonction

**Définition**  
Le **maximum** (resp. **minimum**) d'une fonction  $f$  sur un intervalle  $[a; b]$  est, s'il existe, la plus grande (resp. plus petite) valeur des images  $f(x)$ , pour tout réel  $x$  appartenant à l'intervalle  $[a; b]$ .

**Exemples**

x	a	a	b
Variation de f	↗	↘	↘

On dit que  $f(a)$  est le maximum de  $f$  sur  $[a; b]$  et qu'il est atteint en  $a$ .

x	a	a	b
Variation de f	↘	↗	↘

On dit que  $f(a)$  est le minimum de  $f$  sur  $[a; b]$  et qu'il est atteint en  $a$ .

**1.2** Soit  $g$  la fonction définie graphiquement ci-dessous.

**4.** Donner l'ordonnée du point de la courbe  $g$  d'abscisse 0 avec la précision permise par le dessin.  
**5.** Le point de coordonnées  $(-1; 2)$  est-il sur la courbe  $g$ ?  
**6.** Construire le tableau de variation de  $g$  sur son ensemble de définition.

**5.3** Tracer la courbe représentative d'une fonction qui vérifie les conditions suivantes :  
-  $f$  est définie sur  $[-7; 2]$ ;  
-  $f$  admet 5 pour maximum, atteint en -3 ;  
- -3 est le minimum de  $f$  atteint en 0 ;  
-  $f(2) = 4$ .  
Les courbes obtenues sont-elles toutes identiques ?

**1.3** Lire graphiquement les réponses aux questions.  
**1.** Sur quel ensemble de nombres la fonction  $g$  est-elle définie ?

# Extension to other domains and comparison



In France, the REVEA project 2014-2018.

Studying secondary school teachers' documentation work in English, Physics, Mathematics and Technology.

Comparisons between disciplines:

- different kinds of resources used, different schemes. The documentation work is linked with the identity of a discipline;
- evolutions resulting from digital resources in all disciplines, more time devoted to the search for resources (online); many possibilities to share resources with colleagues, but no stable use yet.

# Methodological evolutions: searching for documents

Building documentation tables (Gruson et al. 2018).

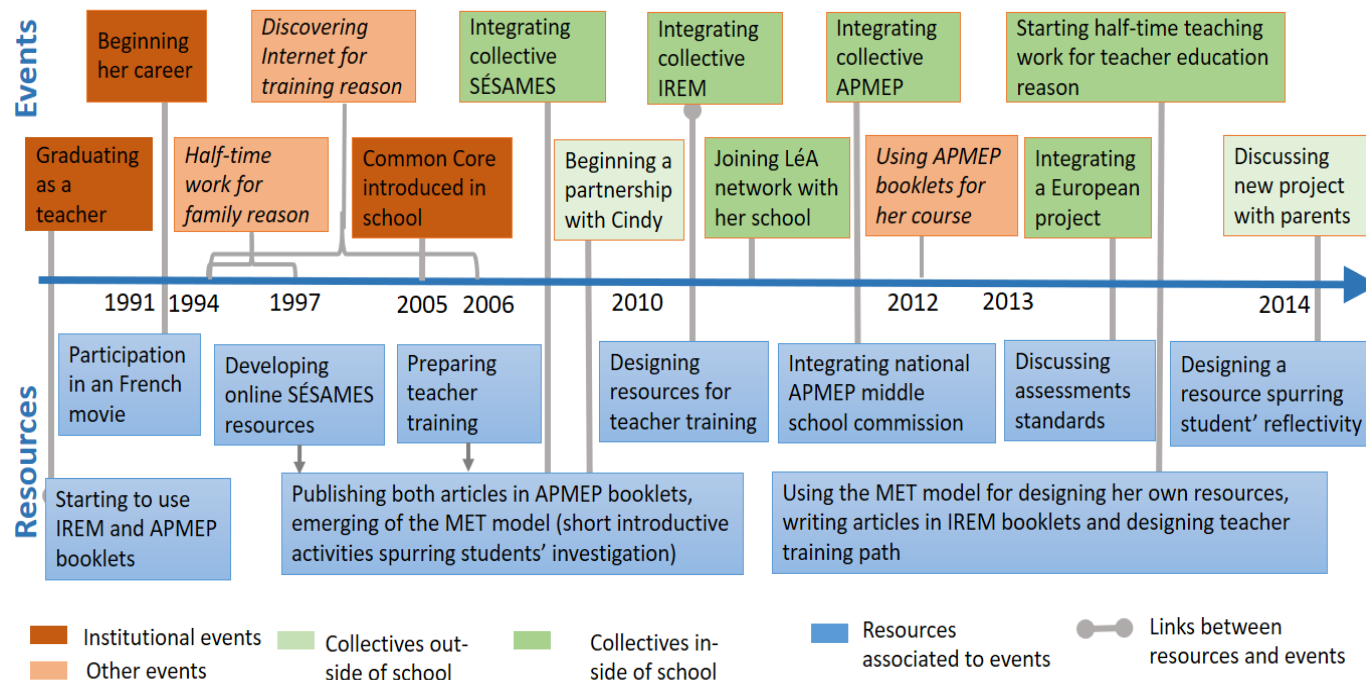
Filled by the researcher, corrected/completed by the teacher

Goal of the activity Prepare and implement...	Resources used	Rules of action	Operational Invariants
A teaching unit organized around a cultural theme	Textbooks Internet (videos on YouTube, texts, images) Personal files	Checks first the class textbook, then looks at the resources she used previously. Types keywords in an Internet browser and follows what is suggested. Chooses resources adapted to her students and easy to use in class.	“In order to stimulate my students’ engagement to speak, I make them speak thanks to documents that interest them” “The cultural theme must have been endorsed and recognized.” “It has to fit in with the agenda.”

# Theoretical and methodological evolutions : investigating long periods of time

Long-life documentational trajectories (Rocha 2018)

A new kind of data: Reflective Mapping of Documentational  
Trajectory (RMDT)



## Theoretical evolutions

*From documents to resources?*

*From documents to resources?*

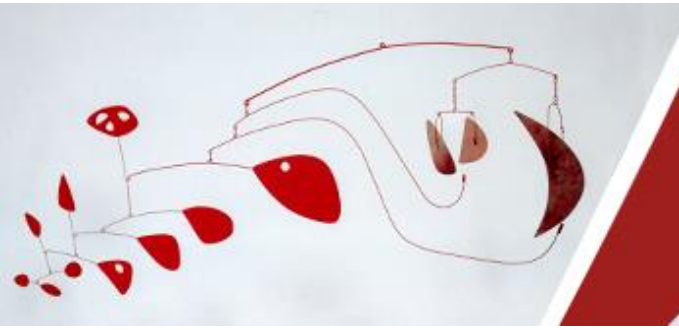
Gueudet & Trouche (2007) : Resource(s) 55% Document(s) 45%

Trouche, Gueudet & Pepin (2018, encyclopedia): Resource(s) 85%  
Document(s) 15%

*Pivotal resources* (instead of pivotal documents): resources used for different classes of situations

Resources systems (revised definition): *the set formed by all the resources used by the teacher*

*And the name of the conference...*



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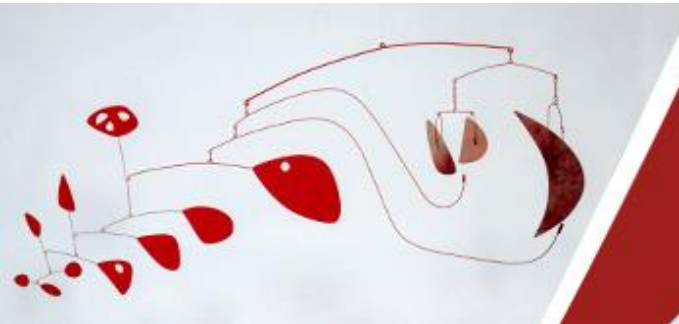
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## Further ongoing evolutions

- Of the questions studied (linked with evolutions of the context);
- Of the theory;
- Of the methods....

Are now produced by the work of many contributors, and will be presented Wednesday in the final conference by Luc Trouche.





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Many thanks to all the colleagues cited and not cited in this presentation, who inspired the initial works on the documentational approach, who contributed to the theoretical and methodological construction, who enriched the approach by their use of it...

Thank you for listening, and

Special thanks to Luc Trouche!

