

RE(S)SOURCES 2018

Evidencing the missing resources of the documentary approach to didactics, towards (10) programs of research



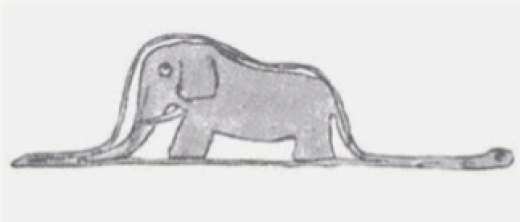
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Documentational approach to didactics (DAD), flashback to the future

Experimenting and proving

Experiencing mathematics in schools with symbolic calculators

38 variations on a given topic



**Luc Trouche and 37 students
of a 12th grade class**

Institute of Research on Mathematics Teaching

Mai 1998

My first book was written with my students

20 years later, in the same 'spirit', the interactions with students / young researchers will contribute to guide my talk

I will draw from these interactions some perspectives for the future, formulated in terms of 10 programs of research.

I am doing this in a free attitude mood, as I will not be in charge of coordinating these programs...

A perspective of transmission...

Outlines



1. Learning from those who have appropriated and developed DAD
2. The productive and constructive aspects of a theoretical framework
3. Back to basics, deepening the model of DAD itself
4. Issues of methodological design
5. Towards a new field of research?
6. Crossing languages for puzzling out names, meanings, structure

1. Learning from those who have appropriated and developed DAD

Productive experiences with other researchers (EducTice, SFoDEM, ReVEA, MC2, MaTRiTT...), scientific stays in Brazil, China, Lebanon, Mexico and Senegal, and this conference itself

... and, as announced, interactions with PhD and post doc students, for example those present in IFÉ since last September...

[In Chinese, 'teaching' may be translated by 教学, meaning teaching-learning]



1. Learning from those who have appropriated and developed DAD

Three questions asked to (current or past) PhD and post-doc students :

- a. You have used instrumental approach (IAD) vs. documentational approach to didactics (DAD). To which extent did these frames support your research?
- b. In using DAD, did you feel some missing resources? In which circumstances? What new resources (theoretical as well as methodological) this approach should develop?
- c. For designing missing resources, which possible theoretical crossings? Which new research programs to be launched?

29 answers, to be combined with the students' real work and their contributions to the field



- PhD theses,
- papers,
- contributions to the Re(s)ources 2018 conference

2. The productive and constructive aspects of a theoretical framework

Questionnaire feedback, which was the support from DAD?



Understanding

- The *potential* of various things for resourcing teachers' work (Carole, Mohammad, Moustapha, Nolwenn, Ulises)
- The *complexity* of the integration processes (Ana, Jose)
- The interactions between teachers and *students* (Gilles)
- The interactions between individual and *collective* teachers' work (Hussein, Nataly)
- The gap between designers' *expectations* and teachers' *uses* (Chongyang +)
- The metamorphosis from *prospective teachers* to teachers at work (Cibelle +)
- Teachers' professional development over a *long period* (Anita, Katiane)

Designing

- Task integrating *digital resources* (Marisol)
- *Digital supports* for helping teachers to design their own resources (Franck)

Rethinking

- *Teacher education* as well as teacher training (Moustapha, Veronica)
- Teachers as resources (D)*designers* and *collective-reflective practitioners* (Sonia)

2. The productive and constructive aspects of a theoretical framework

A flourishing creation of concepts/names answering to new objects/phenomena to be named (see Ghislaine's lecture)



Collectives (C)

- Mother C, daughter C, hub C, documentation-working mate
- Thought collective

Methodological design

- Methodological contract
- *Schematic representation* of RS, *Reflective Mapping* of RS, IMRS, RMDT

Events

- Documentational incidents, didactical vs. critical incident

Knowledge and document (D)

- Scheme, D system, D expertise, affinity, D identity, D trajectory

Resources (R)

- Curricular R, mother R, daughter R, structuring mother R, oriented daughter R, meta-R, pivotal R, hub R, proper R, recycled R, intermediary R...
- Cycle of life of R, block of R, R systems for learning/ for teaching
- Coherence, quality, connectivity

2. The productive and constructive aspects of a theoretical framework

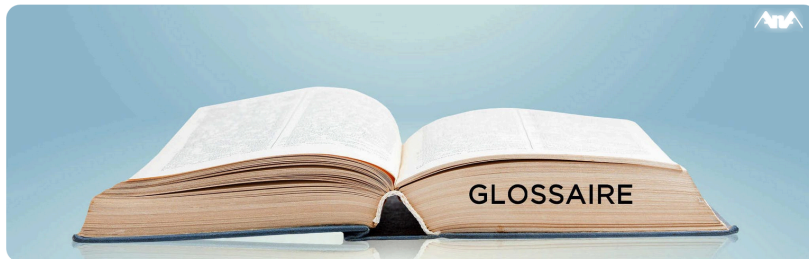


Questionnaire feedback, missing resources

- We need a glossary / a map for situating the concepts developed in the frame of DAD (Hussein, Katiane, Rim...)

Some realizations, to be considered:

- A germ of [DAD glossary](#);
- The glossary of the AnA.doc project (Alturkmani *et al.* 2018);



- The Technology Enhanced Learning ([TEL](#)) meta-project, a platform to support the conceptual integration in the area

A global description of the approach is not enough

The documental approach to didactics

*For publication in the Encyclopedia of Mathematics Education
First draft - not for circulation*

Luc Trouche
Ghislaine Gueudet
Birgit Pepin

Re(s)sources 2018 International Conference
French Institute of Education - ENS de Lyon – May 2018

2. The productive and constructive aspects of a theoretical framework

Program 1: Designing a living multi-language glossary of the documentational approach to didactics

- A condition for developing a scientific community, its concepts and methods
- + a criterion for a set of researchers to develop into a community of practice (Wenger 1998)
- A condition for writing papers in his/her own language

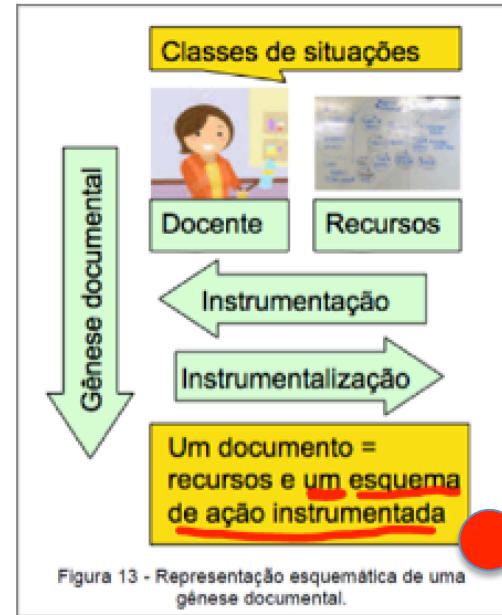
A master class in Shanghai: which Chinese translation for “Instrumentation” or “Document”?

Which English translation for 磨课 ?



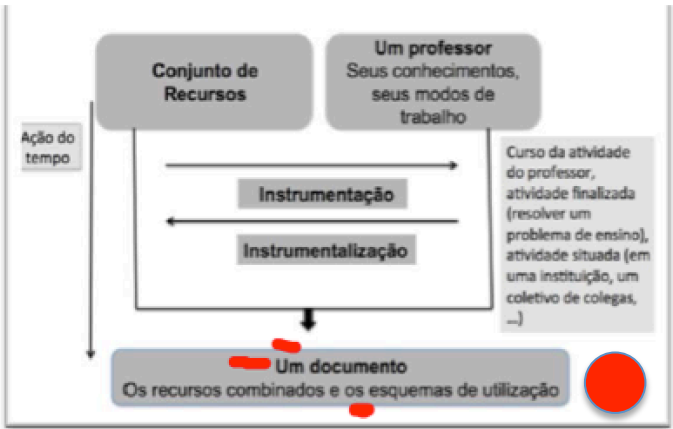
3. Back to basics, deepening the model of DAD itself

Emerging of a theoretical framework, conceptual wavering revealing the underlying complexity
 Ghislaine & Kenneth's lectures, WG 1, 3 and 4.

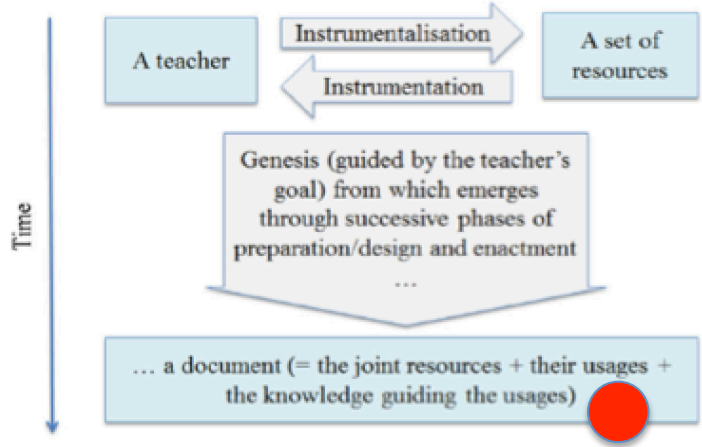
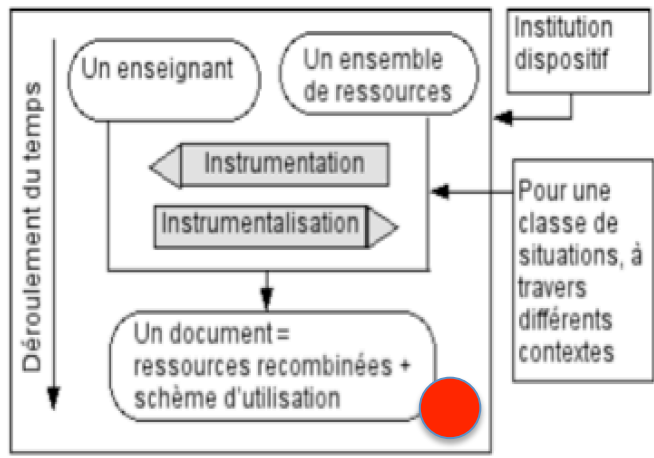


Bellemain & Trouche 2016

Trouche 2016



Gueudet & Trouche 2010



Pepin, Gueudet & Trouche 2017

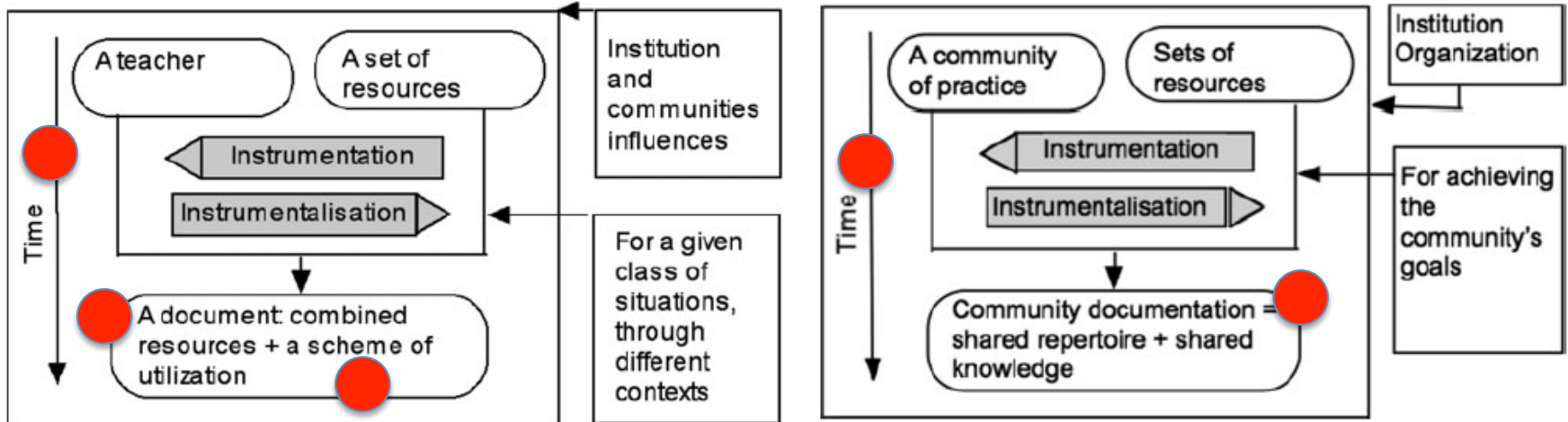
3. Back to basics, deepening the model of DAD itself



Questionnaire feedback, missing theoretical resources

- About resources: gestures, languages, artefacts (Ana, Ulises), resource systems components (Anita, Sylvaine), students' resources (Mohammad)
- Schemes components (Cibelle, Elisangela), epistemic component (Fernando), designing vs. using resources (Michèle), teachers' knowledge (Chongyang), schemes and situations (Anita)
- Individual vs. collective work of teachers, context, effects (Hussein, Nataly Nolwenn, Rim)
- Long vs. short geneses and teachers' professional development (Cibelle, Katiane)

Two schemas from Gueudet & Trouche 2012, a, b

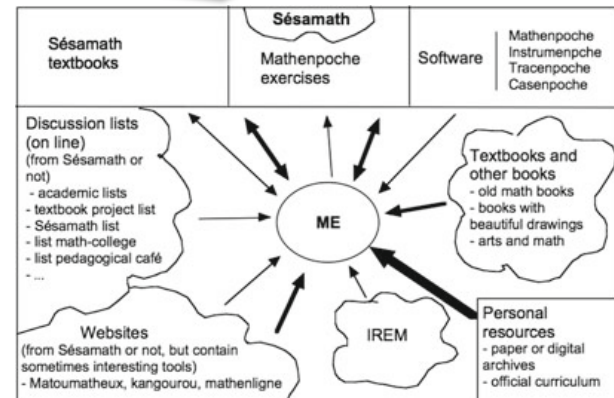


3. Back to basics, deepening the model of DAD itself

Program 2: Deepening the nature, content and structure of a teacher's resource system(s)

- Didactical & epistemological *potential* of a resource
- Designing a typology of teaching resources with respect to their: *nature, position, quality(ies), variability*
- Following Hammoud (2012), distinguishing *mother resource system*, and *daughter resource system*, containing what is already *appropriated / used*?
- Thinking resource system structure, according to: storage location, teacher's activity system, scientific content...
- Teacher's resource system vs. students' resource systems

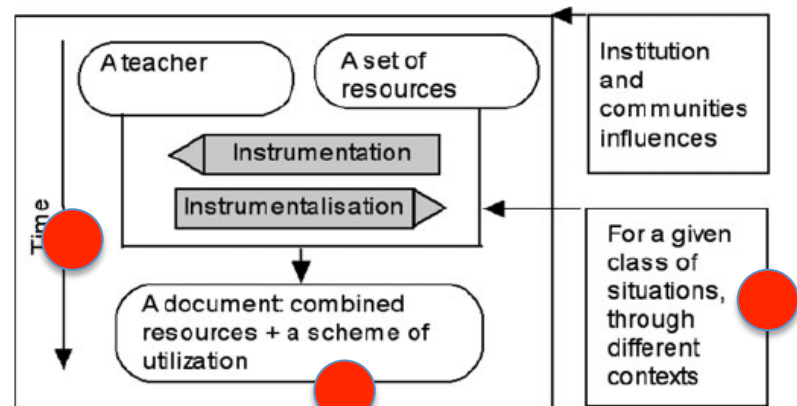
According to Pierre's drawing (Gueudet & Trouche 2012b), Sesamath is part of his resource system. Sesamath, or part of?



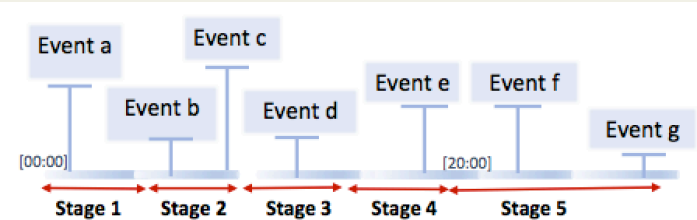
3. Back to basics, deepening the model of DAD itself

Program 3: Deepening the dialectics of schemes / situations of documentation work

- Deepening the notion of scheme (theorems-in-action and concepts-in-action of documentation work?)
- Continuity between knowledge *for designing* and knowledge *for using*?
- Thinking the evolution of the situations themselves “repetition without repetition” (Clot 2008)
- Analyzing situations, stages, events, of a documentational genesis (Trouche *et al.* submitted)
- Thinking the *structure* of teachers’ documentation work



An example of a structure of “preparing a new lesson”



- Stage 1: analyzing the curriculum
- Stage 2: visiting familiar resources
- Stage 3 : selecting some of them
- Stage 3 : writing a lesson plan
- Stage 4 : trying to integrate the new topic in a global progression
- Stage 5: looking for new resources

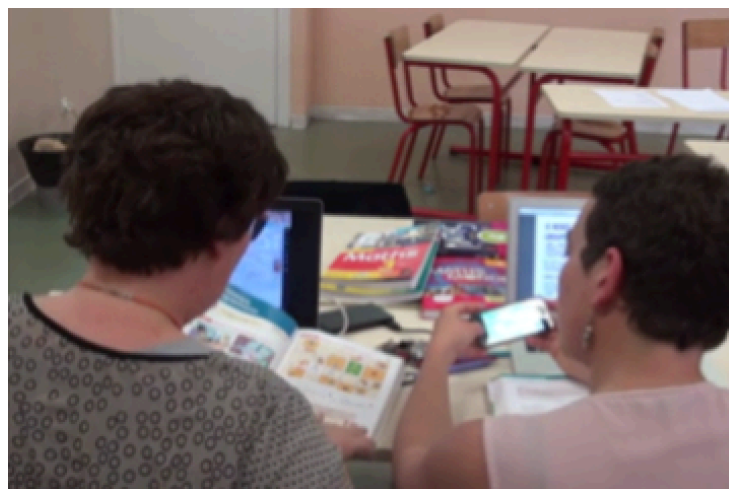
...

3. Back to basics, deepening the model of DAD itself

Program 4: Deepening the analysis of conditions / effects of teachers collective documentation work

- A joint analysis of the collectives and the resources they produce
- Taking into account not only the communities of practice, but a large diversity of collectives (c vs. C), focusing on their frontiers and intersection
- The critical hybrid character of collectives
- Questioning the notion of *collective resource system* and the *social dimension of schemes*
- Thinking the development of collective documentation work as a mean of teacher professional development

The productive setting of *documentation-working mates* (Wang, Trouche, & Pepin 2018)

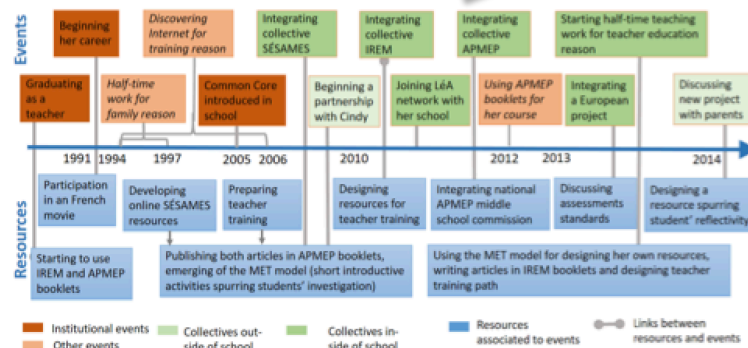


3. Back to basics, deepening the model of DAD itself

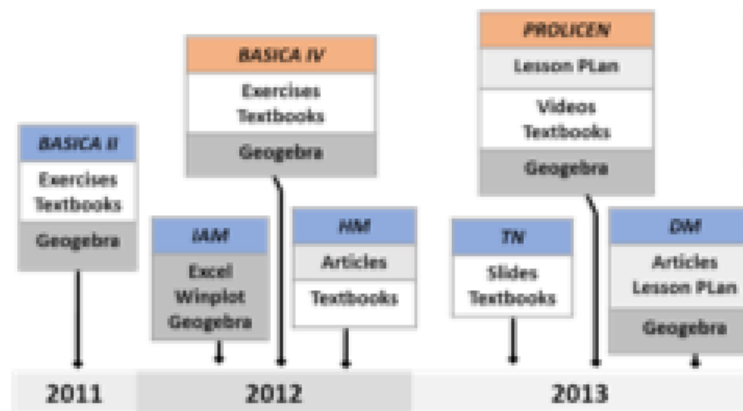
Program 5: Understanding the short vs. long episodes of teachers' documentation work

- Schemes and professional development: the essential dimension of time
- The interest of considering the long periods of time: the notion of *documentational trajectory* (Rocha)
- The interest of considering the short periods of time: “*metamorphosis* from students to teachers” (Assis); *documentational incident* (Sabra 2016)
- Investigating the trajectories of teachers in collectives.

Resources, collectives, and events structuring teachers' documentation trajectories



30 years (Rocha *et al.* 2018)



3 years (Assis *et al.* 2018)

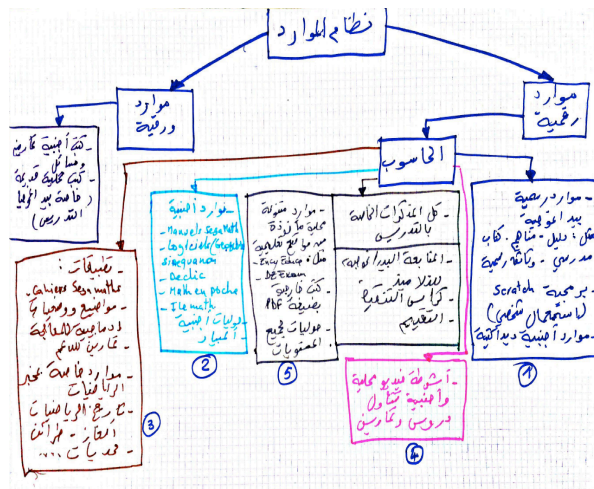
4. Issues of methodological design

From the beginning, DAD has focused on four main ideas:

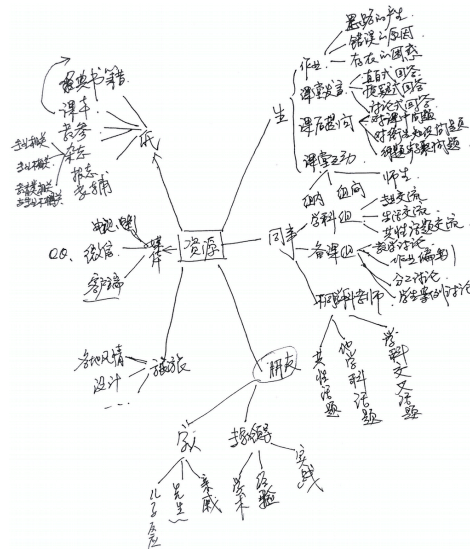
- Focusing on what a teacher uses and produces for designing her teaching
- Focusing on the teachers' work itself (as user/designer/user), in and out of classrooms, as well as on the produces of this work
- Taking into account the diversity of teachers' resources and the long period of documentational geneses
- Using (and stimulating) the reflective view of teachers on their own activity (individual, as well as collective).

“Natural data” and “stimulated data”

Links with WG 2, and with the 4 Workshop sessions



Sayah 2018



Wang 2018



Proust 2018

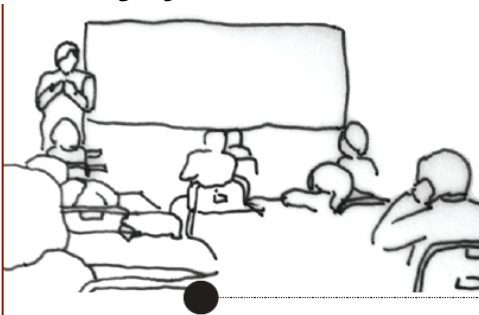
4. Issues of methodological design



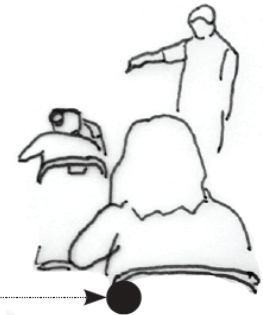
Questionnaire feedback, methodological missing resources

- Need for thinking new ways for allowing a teacher to fill a logbook (for example in combining pictures and annotations) (Sylvaine); collecting informal data (Karima)
- Need for: tracing the resources (like emails, or meeting records) of teachers (Chongyang); studying an evolving resource system (Cibelle); large scale studies (Michael); quantitative analyses (Mohammad); structuring data and developing algorithms (Franck)
- Need for: tools to collect (Luxizi), organize and analyze data (Marisol), particularly in the case of collectives (Nolwenn); *hybrid supports*, combining images and sounds (Sylvaine); *webdocuments* (Veronica)

*Who could read me
the story of Taoki?*



*We will cut it in
three pieces, OK?*

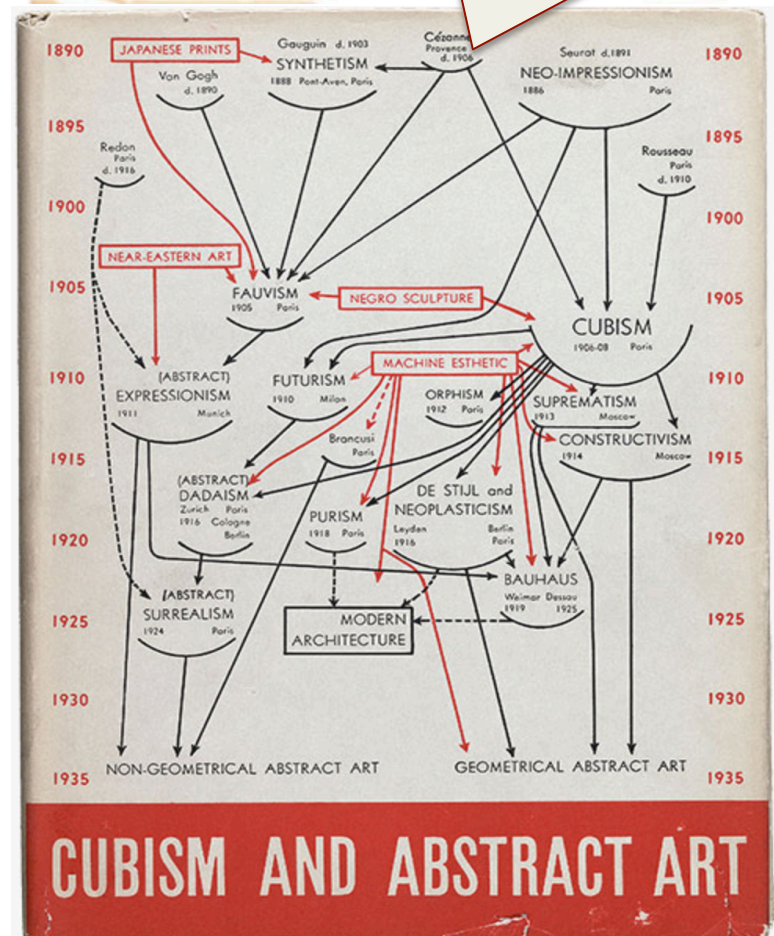


4. Issues of methodological design

Program 6: Stimulating reflectivity;
storing and analyzing related data

- Thinking the time, the place, the 'story' for stimulating reflectivity
- Thinking the tools: logbooks, bitacorras, meeting reports, mappings of resource systems (vs. teachers interactions, vs...) to be dynamically adapted according to questions of research and context
- Thinking tools and methods for analyzing the things produced by teacher' reflectivity
- Individual reflectivity, collective reflectivity?

Alfred H. Barr (1936), founder of the MOMA, mapping the history of Modern Art (Caraës & Marchand-Zanartu 2011)

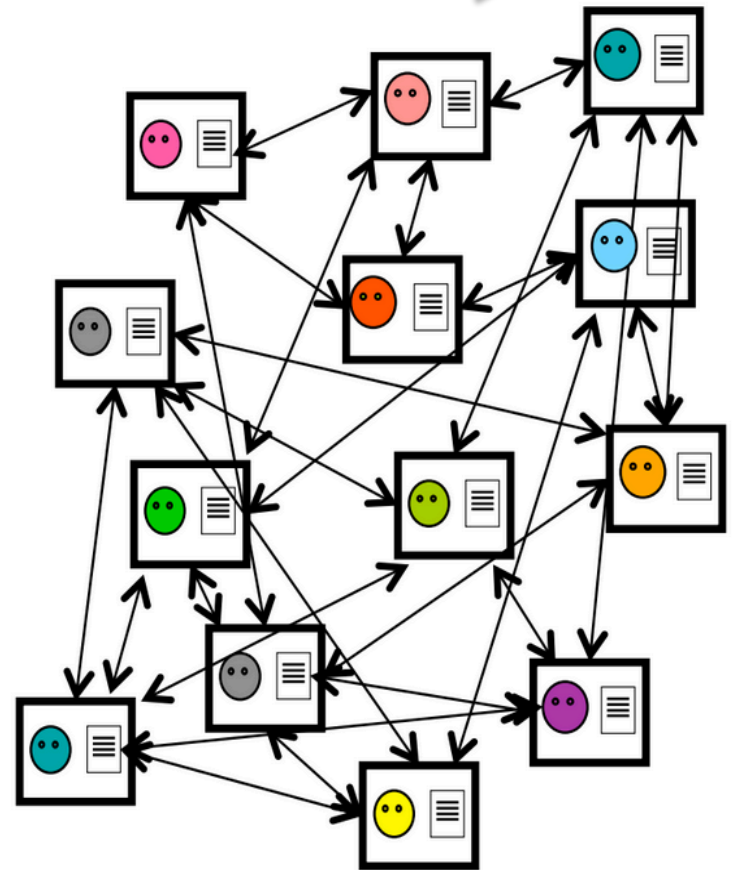


4. Issues of methodological design

Program 7: Developing tools for analyzing a number of data related to interactions between educational actors and resources

- Metadata for characterizing the resources designed and used (Cooper *et al.* 2018) + Workshop session B
- A number of data (due to the uses of the Web, and their traces) to be analyzed
- Thinking fruitful interactions with other scientific fields, particularly Information Architecture...
- ... and Learning (Teaching?) Analytics (= the measurement, collection, analysis and reporting of data about learners and their contexts)

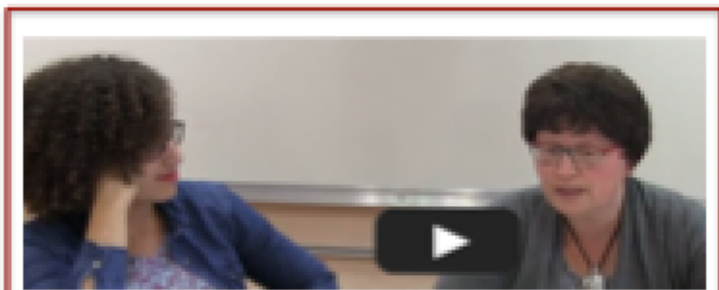
“We miss tools for dynamically following up the documentation work of a given community”
Salaün (2016)



4. Issues of methodological design

Program 8: Thinking specific supports for capturing and analyzing data related to teachers' documentation work

- A need for gathering heterogeneous data and for extracting easily (from videos for example) relevant excerpts (Alturkmani *et al.* to be published)



From 38:25 to 39:45

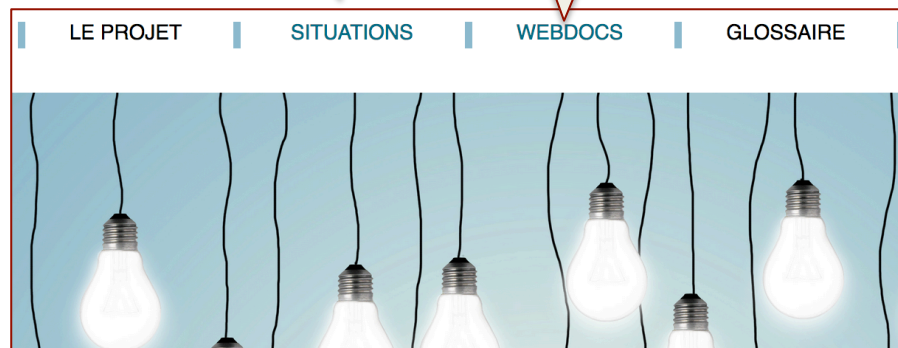
- Other projects in progress (Lucena & Assis 2015, Trouche et Bellemain 2016) + Workshop session C

A set of typical situations of documentation work (evoking her trajectory, preparing a lesson...).

For each situation, gathering 'all' the related data (video, resources...)

For each situation, several *webdocuments* analyzing it according to a given questioning.

A webdoc = a preliminary analysis, supported by excerpts of data, and opening a discussion



5. Towards a new field of research, crossing DAD with?



Questionnaire feedback, possible theoretical crossings

- Crossing with other frames, or deepening the existing ones? Deepening the theory of *instrumental orchestration* (Rosilangela); the notion of *documentational mediation* (Moustapha)
- Crossing with the *existing theories in mathematics didactics* (Gilles, Cibelle); with theories of *technology in education* (TPACK, Jose); with ICS (Anita)
- For exploring in more depth the *nature* of each resource, using *models* of Wartofsky, *theory of objectification* of Radford, *lesson studies* (Ulises); *the theory of variations* (Luxizi), *boundary objects* (Nataly)
- The *Joint action theory in didactics* (Carole)
- Need to develop more in the perspective of *professional didactics* (Rogerio)
- Using *CHAT*, *Anthropological Theory of didactics* (Chongyang), *sociology* (Mohammad), *boundary objects* (Michael, Nataly)
- Social ideas, studying the teacher work in rural schools or poor schools or with specific communities (Marisol), issues of equity and access (Michael)
- *Computer sciences*, for analyzing the structure of systems (Karima)
- *Constructionism* and *computational thinking* (Ana)

5. Towards a new field of research

Program 9: Thinking the 'extension'/'expansion' of DAD

- Thinking in terms of research praxeology (Michèle Artigue)
- Developing DAD in using it in a variety of domains, and for a variety of levels (from pre-primary schools to higher education), in a variety of contexts (social, cultural, formal / informal)
- Thinking the interactions with 'old' fields (as anthropology) and emerging ones, as Learning Analytics, or *Curriculum ergonomics* (special issue of IJER, edited by J. Choppin)
- **DAD: Documentational Approach to Didactics, or Didactical Approach to Documentation?**

Thinking in terms of *Documentational studies*, a way of developing a new multidisciplinary academic field embracing the complexity (Monteil & Romerio 2017) of “teachers interacting with resources”?

An example: *Environmental studies* is a multidisciplinary academic field which systematically studies human interaction with the environment in the interests of solving complex problems (Wikipedia)



6. Crossing languages for puzzling out names, meanings, structure



Questionnaire feedback, last answer

- Need for comparative studies
(Chongyang, Luxizi)

A shared experience when teaching and meeting teachers across cultural and linguistic frontiers, see Christine, Janine, Binyan and Takeshi's lectures, and the panel coordinated by Birgit

The essential question of *denomination* (Rousseau et Morvan 2000)

An interest all the greater as the differences are great between the *thought-languages* (Jullien 2015), for example between Chinese, or Arabic, and the European languages.

See Pepin, Xu, Trouche & Wang 2016

My own experience in teaching in China, and in co-supervising PhD with Chinese colleagues in the frame of the JoRISS program (ENS de Lyon- ECNU in Shanghai)



6. Crossing languages for puzzling out names, meanings, structure

Analyzing an interview of a teacher (educational philosophy in higher education) by the student who made the interview. Extracting and explaining the most frequently word used, in different categories

Category: *The resources designed by the teacher*

- **人格化的材料** the materials processed by the teacher with a strong sense of herself
- **从专业眼光提炼过的材料** materials selected and adapted from a common professional community preference
- **经过教师自己重新理解后的材料** materials re-explained by the teacher
- **转化/活化的材料** transformed / lived materials: the seemingly irrelevant materials developed into academic materials

Category: *Teaching through the way of...*

- **言说** speech, lecture, presentation
- **表演** performance (acting, showing)
- **夸张的肢体动作** exaggerating gestures
- **模拟声响** imitating voices

A way for entering the structure of teachers' resource system

A feature of a given culture, or a way for evidencing something hidden in other cultures?

6. Crossing languages for puzzling out names, meanings, structure

Program 10: Studying *naming systems* used by teachers to describe their resources and their documentation work

- An anthropological approach to teachers resources, taking into account linguistic, cultural, social and historical background
- At the center of the young researcher workshop (session D)
- A long process, needing time and the commitment of a large community of researchers all over the world... (and my main interest from now...)

Some current projects

Denominating the matter of the teachers' work in Mathematics:
a didactical question

Dénommer la matière du travail des enseignants en Mathématiques:
une question didactique

Denominando la materia del trabajo de los profesores en Matemáticas:
una cuestión didáctica

تسمية مادة عمل مدرسي الرياضيات : مسألة ديداكتيكية

数学教师在工作中对物质的命名：来自教学实践的问题

uutal tuur jumptukaayi jàangalekati matematik yi: yoonu xamle

The Lexicon Project

Examining the consequences for international comparative research of pedagogical naming systems from different cultures (Clarke *et al.* 2017)

Crossing curriculum material

A Cross-cultural analysis of the *voice* of curriculum materials (Remillard *et al.* 2014)

10 programs, as possible path to draw vs. to explore

Program 1: Designing a living multi-language glossary of the documentational approach to didactics ●

Program 2: Deepening the nature, content and structure of a teacher's resource system(s) ●

Program 3: Deepening the dialectics of schemes / situations of documentation work

Program 4: Deepening the conditions / effects of teachers collective documentation work

Program 5: Understanding the short vs. long episodes of teachers' documentation work

Program 6: Stimulating reflectivity; storing and analyzing related data ●

Program 7: Developing tools for analyzing a number of data related to interactions between educational actors and resources

Program 8: Thinking specific supports for capturing and analyzing data related to teachers' documentation work ●

Program 9: Thinking the 'extension' of DAD ●

Program 10: Studying *naming systems* used by teachers to describe their resources and their documentation work ● ●

Re(s)ources conference, a moment of a conceptual genesis

From tomorrow, and during two days, a Young Researcher Workshop



- Session A. Interactions with lecturers
- Session B. Roles of didactic metadata
- Session C. Webdocuments for collaborative analysis of teachers' practices with resources
- Session D. Naming systems used by teachers to describe their documentation work

PhD current work, + research projects...

To be published in December, including the lectures and the results of each Working Group

Advances in Mathematics Education

Luc Trouche
Ghislaine Gueudet
Birgit Pepin *Editors*

Resources in Mathematics Teachers' Professional Activity

 Springer

MEDA (ERME)

Mathematics education
in the digital age

Copenhagen, Sept. 2018

Jana Trgalova, co-chair

ICMT 3

International conference
on Mathematics Textbooks

Paderborn, Sept. 2019

Sebastian Rezat, chair

ICME 14

International conference on
Mathematical Education

Shanghai, July 2020

Binyan Xu, co chair of the LOC



Towards a Re(s)ources
2021 international
conference ?

A fruitful metaphor: Intelligent trees

Trees learn, support, interact within a complex, highly interconnected ecosystem, where diversity is an asset, and experience a valued richness (Intelligent trees, Dordel & Tölke 2017)

A symbiosis is formed, underground, between tree roots and mycorrhizal fungi. Through this network, carbon, phosphorus, nitrogen or hydrogen, circulate from one tree to another

After cutting a tree, the subterranean relationships between the tree's roots and neighboring trees intensify for a whole period of time, as if to capture the experience of the cut-off tree

A powerful metaphor for (collectives of) teachers, their resource systems and their knowledge.



A fruitful metaphor: Intelligent trees

The anacardier of Pirangi
One forest = one tree
(thanks to Ricardo and
Cibelle)



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