

# DOCUMENTATION EXPERTISE AND ITS DEVELOPMENT WITH DOCUMENTATION EXPERIENCE IN COLLECTIVES: A FRENCH CASE OF COLLECTIVE LESSON PREPARATION ON ALGORITHMIC

Katiane de Moraes Rocha, Chongyang Wang, Luc Trouche

French Institute of Education, École Normale Supérieure, Lyon, France

[katiane.rocha@ens-lyon.fr](mailto:katiane.rocha@ens-lyon.fr); [chongyang.wang@ens-lyon.fr](mailto:chongyang.wang@ens-lyon.fr); [luc.trouche@ens-lyon.fr](mailto:luc.trouche@ens-lyon.fr)

*With a background of great changes of curriculum reform in France, there comes the new challenge for both (1) the new teaching contents such as the new content of algorithmic and (2) their working way in collectives, such as inter-discipline teaching practice and three-year-cycles. In this study, we are interested to see how the mathematics teachers react to the new challenges from a resource view. The two notions of documentation experience and documentation expertise are used in a case study of Anna and Cindy in our research.*

*Keywords: resource, mathematics teachers, documentation work, documentation experience, documentation expertise*

## INTRODUCTION

From September 2016, the middle schools in France started to carry out the new curriculum program with a series of great changes: the curriculum is organized on three-year-cycles without details of what has to be done in each level of the cycle, besides, the last two grades in primary school (Grade 4 and Grade 5) and the first grade in lower secondary school (Grade 6) are put in cycle 3, which demands more cooperation and communication between teachers within the same school and the primary schools. The components of computer sciences, algorithmic and programming, firstly appeared in cycle 4, with the contents separated into mathematics and technology. To contribute to the idea of interdisciplinary teaching practice, each school has to choose at least three interdisciplinary teaching activities, thus for example, algorithmic and programming becomes a choice for mathematics teachers and technology teachers. Great changes also come with great challenges: the French middle school mathematics teachers never teach or be trained how to teach this topic before, lots of teaching resources need to be developed; and cooperation between teachers from different disciplines needs to be tempered because although it is stated that “teaching is collaborating” in French Dictionary of Pedagogy (Buisson, 1911), most of teachers in France prefer working individually than collectively.

With an aim to explore how mathematics teachers react to new challenges, we situated our study in a time of French curriculum change, with a French middle school math teacher, Anna, and her collective work with her colleague, Cindy in a lesson preparation on algorithmic and programming as a case study. Without any teaching and training experience, to teach algorithmic and programming successfully, teachers have to integrate their available and potential resources. We assumed that there remains some expertise in teachers’ resources integration, which is closely linked to the resources accumulated from their experience in both learning and working. As cooperation among teachers is considered important for teacher professional development (Hargreaves, 1995), we pay a specific attention on the collective aspect. We are interested to see: How does teachers’ experience in collectives benefit their resource work when preparing a new lesson? How does teachers’ collective work contribute to their expertise in resource work?

In the following sections, we will start from our theoretical frameworks, introducing the concepts of *documentation experience* and *documentation expertise*, and then with a more precisely stated research questions, we proposed our research methodology and tools. In the fourth part, we will analyze the French case from documentation experience and documentation expertise. As a conclusion part, a summarization of the relationship between documentation experience and documentation expertise will be presented.

## THEORETICAL FRAMEWORKS

Our study is based on the *Documentational Approach to Didactics (DAD)* (Gueudet & Trouche, 2008). In this section, we will present our theoretical choices for analyzing collective dimension in teachers’ work with resources, with two new concepts, documentational experience and documentation expertise, for analyzing teachers work with resources.

With an interest on analyzing and understanding teacher professional development, we chose a view of resource: according to *DAD*, the first theory framework of our study. Professional development is defined as the results of an interrelated process of incorporating new resources to the teacher's work, the development of her knowledge for teaching and her relationships with other participants of this process. The interactions between teachers and resources, including restricting, selecting, modifying, adapting, saving and sharing off, are defined as *documentation work* in *DAD*, and *resource* could be anything with the potential to *re-source* teachers' activity (Adler, 2000), and the structured set of resources a teacher is working on/with is named her resource system. Along with teachers' integrating continuously new resources, there is a process of generating the schemes of developing a resource, incorporating the resource produced and its usage, thus defined as a *document* in *DAD*. Scheme is defined by Vergnaud (1998) as an invariant organization of activity for a given class of situations, comprising goals, rules of action, knowledge and possible inferences. The framework of *DAD* provides a resource-view on teachers' work, both individually and collectively, with the elements to be analyzed: resource, goal(s), rules of action, and knowledge.

While taking *DAD* as a framework to see the resource perspective on teachers' work, there also comes the question of the nature of teacher work: their work is neither isolated nor individual, but part of society, their documentation work is connected to others, and culturally and socially situated (Gueudet *et al.*, 2013). Thus to explore the factors of collective, we adapt two different frameworks to explore how do documentation experience in collectives nourish documentation expertise:

- The *thought collective* (Fleck, 1934), for analyzing teachers collective work over time, the broad definition of *thought collective* proposed exists when "two or more people are exchanging thoughts" (p. 44) and generates a *thought style* "characterized by standard features in the problems of interest to a thought collective, by the judgment which the thought collective considers evident, and by the methods which it applies as a means of cognition" (p. 99);
- *Activity theory* (Engeström, 1987), for understanding and analyzing teachers' collective activity with a structure of situating three components (subject, instruments, object) into the background collective (the role of the subject in the activity, the rule of the collective, and the labor division in the activity), which links the teachers' activity with the social and cultural elements of the collective where the activity occurs. It also echo *DAD* from its principles as (1) collective, artifact-mediated and object oriented; (2) multi-voicedness which calls on listening to the other members besides the subject in the activity; (3) historicity, in both the history of the collective and the history of teachers' activities in this collective; (4) the central role of contradictions as sources of change and development.

The open definition of collective of Fleck (1936) allow us to analyze collective work of different nature: formal or informal, regulated or not, stable or transit, required or voluntary, collaborative or cooperative, etc. We use the term cooperation and collaboration as Roschelle and Teasley (1995, p. 70): cooperation "is accomplished by the division of labor among participants" and collaboration "as the mutual engagement of participants in a coordinated effort to solve the problem together".

In teacher's day-to-day activity documentation work happens: when she decides to join a new collective, or meets new resources, or has to face a curriculum change, or has to take into account students with special needs. And in these activities teachers accumulate their *experience* working with resources. And we kept the definition of experience of Pastré (2005), which could be understood as the *accumulation of the past as the accumulation and appropriation of the past* by the subject. As we focus on the resource-aspect of working experience, we call this experience related to teachers' documentation work as *documentational experience*. For analyzing teacher's documentation experience accumulated in collective work we first, collective *thought style* and for that we proposed three points inspired in Fleck (1936) definition: collective's interest *standard features* (CSF) (targeted audience, objectives, missions, types of resources designed, etc.), collective's *judgment* (CJ) about mathematics and teaching mathematics (pedagogical assumptions, point of view about

mathematics digital resources, institutional purposes for teaching mathematics, etc.) and collective's *methods* (CM) for creating resources (functioning mode, member status, type of interaction, etc.). Still following the reflective investigation perspective, we use self-collective's description (charts, status...). After, we identify in Anna discuss what she did in these collectives in relation to new curricular changes.

In a similar way, we proposed another new notion of *documentation expertise* (DE) as teacher's expertise in their documentation work. In Berliner's study (1988), expertise "is *specific to a domain*, and to particular contexts in domains, which is developed over hundreds and thousands of hours". Key elements of expertise are linked with teaching problems solving efficiently and creatively with a wide range of knowledge and experience (Sternberg & Horvath, 1995), or more precisely, teachers with "adaptive expertise" were proposed as "specialists in retrieving, organizing, utilizing, and reconsidering their professional knowledge and beliefs" (Avalos, 2011). Drawing from the definitions of expertise and documentation work, DE is defined preliminarily as the abilities and related knowledge to deal with the whole process of interacting (retrieving, selecting, organizing, modifying, adapting, creating and sharing off) with resources. It is considered as a developing resource-aspect state of teacher professional development.

In this way, we re-formulate our research questions as: for preparing a new lesson on algorithmic,

1. How does teachers' documentation experience accumulated in collectives benefit their resource work?
2. How does their collective work contribute their documentation expertise?

We hold a hypothesis that in front of new challenges, teachers will integrate the resources from their corresponding documentation experience into their current work, documentation expertise could be seen and developed through collective work by teachers' mutual interactions on documentation experience, such as conflicts, complementation, questions and answers.

## METHODOLOGY

Based on DAD, our study mainly adapted the reflective investigation, which involves the teachers as part of the study throughout the whole data collection, with the four principles of "*long-term follow-up*", "*in- and out-of-class follow-up*", "*reflective follow-up*" and "*broad collection of the material resources*" (Gueudet *et al.*, 2013, p. 27). We will present our methodological design in three parts. First, we present our tools based in the principles of reflective investigation. After, we will present the collective putting in evidence the choice the concept of documentation-working mate.

### **Reflective investigation tools**

Different from the traditional investigation, reflective investigation involves the teachers as part of the study throughout the whole data collection, which means the teachers are not only the data provider, but also the data creator. In this way we have two types of tools for following the teachers:

- (1) To know how the teachers organize and represent their available resources, the tool of "*schematic representation of the resource system (SRRS)*" (ibid, P. 28) was kept, where a teacher is asked to draw a schematic representation of the structure of the resources she uses. To be noticed that this SRRS is not a final one, but improved, complemented, and reorganized continuously with the development of teachers' cognition on their resource system.
- (2) Online "*Reflective Investigation Box (RI Box)*" was built and shared between us and the targeted teachers, in which the teachers could share their resources used during the activities (such as lesson plans, screenshots of blackboard writing etc.), and respond the questions (either about resources in RI Box, or any other questions) from the researcher regularly. Considering the using habits of the targeted teachers, we use Dropbox to support the RI box.

### **Documentation-working mate**

To understand how teachers develop DE during their daily work, it is needed to situate the targeted teacher into a collective. Following the principle of "multi-voicedness" of AT, a new notion of *documentation-working mate* is proposed here as

someone who works closely with the targeted teacher, with mutual influences on their documentation work and DE development. *Mate* in Oxford Dictionary infers “a fellow member of joint occupant of a specific thing, like table-mate”, with an “origin related to meat (the underlying concept being that of eating together)” (see in <https://en.oxforddictionaries.com/definition/mate>). The reason to choose “mate” but not “peer” as in “peer education” (Turner & Shepherd, 1999) is that “mate” breaks the boundary of age and education/professional background. For a given teacher, her documentation working could be a colleague with similar working experience in her school, or someone from a totally different working context as an university or research institute etc. In each case of this study, a *documentation-working mate* will be selected according to the targeted teacher: they form a smallest but closet collective, and the documentation-working mate will be followed in the same way as the targeted teacher.

With a broad meaning of “resource”, a variety of information from the teachers is considered in our study: emails, CVs, published papers and articles, blogs etc. Observations and interviews are intertwined: while observing school activities (such as classroom teaching or teachers meetings), field notes were taken by the researcher.

### **A two step case study analysis**

Designed as a case study, two mathematics teachers were selected from a same middle school in France, Anna as the main teacher, and Cindy as her documentation-working mate. Anna is selected because of her rich working experience in collectives, and she proposed Cindy as her documentation-working mate because: they are both experienced teachers (started to work together since 1990) and they both participate in several collectives; they have cooperated with each other in the same school over ten years (since 2006); they both work as part-time in education research collectives and they are willing to attend our research.

A two-step case study analysis includes a preliminary analysis from individual level, and a deep analysis from collective level:

-The preliminary study mainly focuses on the main teacher, Anna’s resource work experience in collectives, as well the resources and resource habits gained in these collectives. We will identify the *thought style* of the collectives that Anna participated and how they support her preparation for new curricular changes;

-As for the deep analysis, we adapted video analysis on a collective lesson preparation between Anna and Cindy, from two dimensions: the documentation expertise shown in the collective work, and how it is developed by their interactions. Details will be presented in the following section.

### **CASE STUDY AND ANALYSIS**

Graduated in 1989, Anna passed her CAPES (Certificate of Secondary Education Professional Qualification) exam in 1990, after one year’s pre-service teacher education, she got her first position in a middle school of urban Paris, a “famous” school for the tricky problem students, till 1995. From 1995 to 2005, she worked in a middle school in Lyon. Then since 2005, she starts to work in the current middle school with three classes. And, we will present our analysis in two parties: first, we will analyze Anna documental experience working in different collectives, and second we will analyze Anna documentation-working mate with Cindy.

#### **Anna documental experience nourishing itself of a plurality of collective**

In this section, we will address the research question: *how does teachers’ documentation experience accumulated in collectives benefit their resource work?*

We present our analyses about Anna collective works for preparing for new curricular changes in two parts: first, we will present her work in three regulated collectives, in which we could infer some elements about their thought style in their site; second, we will present her work in one informal collective, in which we follow Anna works inside it, then we infer they thought style.

We start for older regulated collective that she is member the SÉSAMES, in which teachers and researchers discussing Algebra. Anna met SÉSAMES coordinator, Sylvie Coppé, in her school and she invites Anna to join the collective. Anna hesitated, because Algebra was not her favorite notion to teach. However, she enjoyed this collective in 2006. For observing SÉSAMES site (<http://pegame.ens-lyon.fr/>) we could infer their thought style as:

- Teachers and researchers thinking about resources for teaching Algebra and promoting teacher's training (CSF); mathematics for solving problems and teaching mathematics basing in activity of research by students; collaboratively and voluntary work between teachers and researchers, principles for creating resources (CM).

SÉSAMES is an important collective for Anna documental experience, during more then 10 years of work she created a hug resource system to teach Algebra. And for the new curricular program, the members started to review all resources and think about some programs of calculus to be used in algorithmic. For example, one important resource that they will use for teaching is the *Mise en train* (MET). Resources MET are created for exploring one notion in a progressivity way, during many sections, that was applied in the fifteen first minutes of class lesson. This resource was used in others collectives: IREM, APMEP, ANNA-CINDY collective, among others.

In the national French institute of research, IREM, teachers and researchers research together how to improve teaching mathematics. And Anna uses their resources since she started to teach. And in SÉSAMES she met some members of this collective then she decided to join them too in 2010. For observing IREM site (<http://math.univ-lyon1.fr/irem/>) we could infer their thought style as:

- Articulated work between research and practice looking for diffusing research results and promoting teacher's training (CSF); mathematics in live and teaching mathematics malleable (CJ); collaboratively work for designing resources, not have specific principles for creating resources, but created resources with didactical advices (CM).

IREM have discussed teaching by competences since 2006 when the new common core was implemented in France. This common core is the base of new curricular change, then Anna discussed there how teaching by competences. Also she designs new activities to teach in the interdisciplinary way. And in this collective, Anna had access to many resources about teaching algorithmic exchanging with members.

In the teacher's professional association, APMEP, in which teachers working together for thinking about teaching mathematics. Anna also uses their resources (booklets with activities, articles in their site, etc.) since that she started to teach. And in 2012 she goes from simple consumer of resources to the member of the association. For observing APMEP site (<http://www.apmep.fr/>) we could infer they thought style as:

- Gathering teachers teaching mathematics from pre-primary schools to University and promoting teacher's training (CSF); being a force of proposal for improving mathematics teaching and providing math teachers with rich resources (from a didactical and epistemological point of view) (CJ); working voluntarily and collaboratively without hierarchy, not having specific principles for creating resources, but created resources with didactical advices (CM).

Anna re-interprets and takes position about curricular changes in this collective. They have meeting in which they review all notions proposed in curricular program, in particular, they discuss about algorithmic and programming. In this collective, she shared in their site some resources that she found online for supporting teaching in the new reform.

The last collective that we will explore here is ANNA-CINDY collective, in which they always prepared their lesson together. We recorded their lesson preparation for teaching algorithmic and programming, and we use that for infer some elements about their tough style:

- Anna-Cindy collective thought style: prepare their lesson together in a moment the exchange their experience about teaching (CSF); about algorithmic and programming they look for activities to teach algorithmic as thinking about mathematics, they did not want to teach as used one software (CJ); gathered all possible resources that may

be interesting to use (many textbooks, sites, etc.); discuss them and take all decisions together collaboratively exchanging their experience (CM).

In this collective Anna prepare her activities for teaching this new content that will applied in class and shared her experience about lesson implementation. In the next section, we present more elements about resources designed in this lesson preparation.

Finally, in this section, we evidenced that Anna use collective work as one network for preparing her teaching in the new curricular program. Specially, about her documentation experience for teaching algorithmic and programming, she: interprets curriculum proposes in APMEP, discuss some activities for teaching Algebra in SÉSAMES, exchange activities in IREM and design her planning activities with Cindy.

### **A deep analysis on a collective lesson preparation of Anna and Cindy**

In May 2016, a video of collective lesson preparation between Anna and Cindy on algorithmic was filmed, when it was the time to prepare their teaching plans for the following academic year, and decide the textbooks to be used. This collective lesson preparation lasted for one hour, which was proposed by Anna, with the reason that they were used to prepare lessons together. An email with three questions was sent before their collective work: What are the difficulties for teaching this topic? What resources do you have and lack of? Why do you prefer to work together?

The first transcription was shared with Anna through Google document, in which we marked our confusions and questions in the video, particularly the name of the resources that are unclear for us. Then with the second transcription, we discuss with Anna face-to-face, mainly on the source of the resource appeared in their collective lesson preparation. This section will analyze it from two dimensions: the documentation expertise (schemes) shown, and how it is developed in the collective work:

(1) Some schemes of resource work could be found in this collective activity:

The schemes of retrieving resources, which are also based on the schemes of resources management or storage. It could be an ability to make the use of the available resources. In the eyes of Cindy, Anna herself is already a kind of resource: “When I need some resources, Anna is always the first choice”. Her documentation expertise could be traced back to her online working habit, in both the organization and preparation: with various high qualified website resources, she has Google drive to shared documents and agendas with her colleagues in SESAMES team, Dropbox with her colleagues in her school. Meanwhile she stored her personal resources in Dropbox and Evernote, in which the documents are classified by the name of different collectives and projects. She has also some online platform like Pixies and Viaéduc to collect and store her favorite resources so that when she needs some resources she could find them easily.

The schemes of selecting resources, which rely on the understanding on activity goals, related concepts, and their teaching practices. For Anna, she is clear that the first lesson preparation of algorithmic should be an introduction with some activities. She has her own understanding of algorithmic, which is different from the explanations in the official program, and this is the basic for her critical thinking on the official resources and the suggestions from the inspectors. The critical thinking in resources selecting also relies on the confidence and proficient knowledge about their teaching practice, for example, when Anna and Cindy were reading the goals of algorithmic in a textbook, they doubted that the goals written (“encourage the students to understand the variables...”) impossible, because “it is a notion in information”, so “it is better to change the name”.

The schemes of modifying and adapting resources need the teacher’s understanding of the situation requirements, and technology skills. Such trends appear more obvious on Anna, she has no personal office space, so she has to take her laptop all the day. According to an interview, as a mathematics teacher in middle school, Anna does not need to learn very complex software, and her first big challenge was the whiteboard when her school equipped it in each classroom, and she had to learn how to use it, which cost her almost one year. She explained happily that her students learned much quicker and often assisted her. This is also an open mind or a kind of curious towards new things, and new changes.

The schemes of resources sharing, which is not a spirit of contributing others, but an efficient way of mutual benefiting. Taking Anna and Cindy as an example, Cindy used to say directly that when she had some problems in searching information and resources, she will turn to Anna and she always got her answer. And also from the observation of their school meetings or co-training in service teachers, Cindy seems to be strong to propose her ideas, comments, and suggestions in a clear and reasonable way. The sharing off of resources is not only an action of throwing the resources into the common area, but a carefully maintained, regular refreshed and re-organized, just like the common folder named “le cours” shared among Anna, Cindy and other mathematic colleagues.

Besides, for both Anna and Cindy, there is a kind of flexibility in integrating resources into different roles. This could be evidenced by their presentation on the difficulties and available resources at the beginning. They both traced back from teaching experience to training experience, and then to their learning experience in university and students’ activities they ever organized. This kind of scheme is not only integrating resources from different sources (or collectives) to their current task, but also their current work could be the future resources for other tasks. For example, when teaching the “line, segment and half-line” chapter, she arranged several drawing exercises, which come from IREM website, as classroom exercises for students. Then she collected and took pictures of their work, and uploaded to the school webpage for inter-discipline students’ masterpieces; she also adapts these as examples to her teacher-training work, shared and discussed with other teachers.

- (2) Seeing from the dialogues between Anna and Cindy, their interactions were classified in three types: disagree and conflicts, agreements and complements, questions and answers. The interactions are considered as a mutual way in developing documentation expertise:

The conflicts could be seen when they hold different ideas, but between Anna and Cindy, there are not obvious or strong conflicts seeing from their dialogues. Taking their first ideas about the Scratch as an example: At the beginning, Cindy seems to agree with teaching Scratch according to the suggestions in the program, when she heard the word “but...” from Anna, she tried to remind her that the inspectors also suggested to use Scratch. When Anna explained that algorithmic should be a kind of thinking rather than using a software usage, Cindy seems to change her ideas, she reacted with “Hum” and “Yes”. Later she commented that almost the whole activities suggested in the program are centered with Scratch, then Anna re-stated her idea that she do not want to teach Scratch. However, in the end, they decided to arrange a computer lesson for the students to let them explore Scratch. This could be seen as a process in exchanging their ideas, and influences on each other.

There are more agreements and complementation in this collective work, and they appeared more tacit agreement when Anna and Cindy were discussing the textbooks, they read textbooks on their own, they had their division for these 13 textbooks, and they shared the valuable parts, and exchanged he doubtful points.

In this collective work, the questions and answers happened when one teacher did not know something, and the other explained it. Anna plays more roles on solving the questions proposed by Cindy. For example, when reading the Sésamath textbook, Cindy asked Anna “How do you understand ‘some languages are not used in a declared way’?”, Anna proposed an example of Python, the equal (“=”) is not the equal that we know normally, “it is specific, but it has a different meaning”. Also, when Cindy proposed the “idea of dance” in the document of creative computing, she also explained the source and author of the document, it is the first time heard by Anna, but she learned this after it is explained.

## DISCUSSION

After a two-step analysis on Anna’s documentation experience in collectives and her documentation expertise shown and developed in collective work with Cindy, we find some answers to our research questions: documentation experience in collectives for the teachers not only bring resources to them, but also some thought styles that guide resource design; she takes resources from one collective to another, for example, the resource MET; while in new collective documentation work, ANNA-CINDY collective develop their documentation expertise through trying to adapt those resources and

thought styles into their new work. When exploring an individual teacher's professional development, it is needed to situate her/his work in not only her personal documentation work, but also her documentation experience in collectives, because interactions within collectives could be a crucial way of learning, and developing her documentation expertise.

## REFERENCES

- Adler, J. (2000). Conceptualizing resources as a theme for teacher education. *Journal of Mathematics Teacher Education*, 3, 205–224.
- Avalos, B. (2011). Teacher professional development in teaching and teacher education over ten years. *Teaching and Teacher Education*, 27(1), 10-20.
- Buisson, F. (Ed.) (1911). *Nouveau Dictionnaire de Pédagogie et d'instruction primaire*. Paris: Hachette. Retrieved in September 2015 at: <http://www.inrp.fr/edition-electronique/lodel/dictionnaire-ferdinand-buisson/>
- Berliner, D.C. (1988). Describing the behaviors and documenting the accomplishments of expert teachers. *Bulletin of Science Technology and Society*, 24(3), 200-212.
- Engeström, Y. (1987). *Learning by expanding. An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.
- Fleck, L. (1981). *Genesis and Development of a Scientific Fact*. Chicago: University of Chicago Press (original edition, 1934).
- Gueudet, G., & Trouche, L. (2008). Du travail documentaire des enseignants: genèses, collectifs, communautés. Le cas des mathématiques. *Education et didactique*, 2(3), 7-33.
- Gueudet, G., Pepin, B., & Trouche, L. (2013). Collective work with resources: an essential dimension for teacher documentation. *ZDM - The International Journal on Mathematics Education*, 45(7), 1003-1016.
- Hargreaves, A. (1995). Beyond Collaboration: Critical Teacher Development in the Postmodern Age. In J. Smyth (Ed.), *Critical Discourse on Teacher Development* (pp. 149-173). London: Cassell,
- Roschelle, J., & Teasley S. D. (1995). The construction of shared knowledge in collaborative problem solving, In O'Malley C. (dir.), *CSCL* (pp. 69-97). Springer-Verlag.
- Pastré, P. (2005). Genèse et identité. In P. Rabardel, & P. Pastré (Eds), *Modèles du sujet pour la conception: dialectique activités développement* (pp. 231-260). Toulouse: Octarès.
- Sternberg, R. J. & Horvath, J. A. (1995). A prototype view of expert teaching. *Educational Researcher*, 24(6), 9-17.
- Turner, G. & Shepherd, J. (1999). A method in search of a theory: peer education and health promotion[J]. *Health Education Research*, 14 (2), 235-247.
- Vergnaud, G. (1998). Toward a cognitive theory of practice. In A. Sierpiska, & J. Kilpatrick (Eds.), *Mathematics education as a research domain: A search for identity* (pp. 227–241). Dordrecht: Kluwer.