A study regarding the genesis of the primary teachers' practices who teach mathematics

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This communication fits in line with researches carried out concerning classroom practice in mathematics. Our work aims to better understand how to develop and to stabilize the practices of three primary school teachers who teach mathematics during their Initial Teacher Training (ITT) year and their first year of activity. Thanks to an original methodology, which borrows from didactics of mathematics and from ergonomic psychology, we describe the teacher's activity as a procedure of changes of the original project. The main obtained result is that everything occurs as if the practices of these three teachers were marked by predetermined elements that condition their activity, but also the development of their practices.

1. Presentation of the research

This communication fits in line with researches carried out concerning classroom practice in mathematics. Our work (carried out in the context of the preparation of a thesis) aims to better understand how to develop and to stabilize the practices of three primary school teachers who teach mathematics during their Initial Teacher Training (ITT) year and their first year of activity.

The genesis of practices issue is quite complex. That is why we choose to use a means of privileged access to the teaching practices: it is a question of observing the training of these practices through the analysis of the effects of a training scenario. In other words, in order to study how the practices are constituted, we look at an intervention, which precisely aims at work the training of the practices: Professional Practices Analysis Workshops. During these workshops, trainee teachers, who are organized in small groups, develop and implement a sequence of mathematics with a professional trainer and a teacher belonging to the IUFM's («Institut Universitaire de Formation des Maîtres»; teacher training institutes). The sessions conducted by the trainee teachers give rise to an "*ad hoc*" analysis and then to a deferred analysis by means of the use of the video.

In our work, it has to do with the accompaniment of the pre-service teacher and the description of what happens during the time the sequence project is being prepared until of its implementation while taking into account the training scenario effects on their practices. That is to say, what is due to the script itself, the constraints imposed by the training, the situations chosen by the trainers and so on.

2. Theoretical framework and general methodology

According to us, this research fits in the "cross approach of teaching practices" framework developed by Robert and Rogalski who articulates an ergonomic approach and a didactic

approach. From the didactic viewpoint, they consider practices for their learning objects. From the psychological viewpoint, they consider the teacher as a professional at work, they consider that her/his profession has its own rules, its standards and its constraints.

We adopt the working assumption that teaching practices are "complex, stable and consistent" and make it our own. Our intention consists in showing that there is a beginning consistency in the practices of each teacher followed from the ITT year and in studying how their practices progress during the first year of activity.

Some of the researches conducted under this "cross approach" have emphasized the consistency of the practices adapted by former teachers having many years in their career. The methodologies used in this work consist in performing a "cutting up" of the practices observed in various components (Masselot, 2001) or in various dimensions (Roditi, 2001) then to look for possible conflicts between the different elements incurred by dint of the cutting up.

We suggest a different approach to the consistency in practices. Unlike the referred works, our method aims not to cut the practices in different elements in order to put them in parallel then, but rather to develop a model for analyzing the activity of the teacher who provides a first set of results from which we highlight a kind of "logic" that guides the action of the teacher. This choice is based on assumptions that we consider as being a prerequisite for our work.

In fact, we venture the hypothesis that the practices of a teacher are consistent, as long as he was given a general project of teaching and has adequate means to implement it. We also believe that this project develops from the initial training.

Thus, we presume that while adapting the projects proposed by the trainers within the framework of these workshops, the untrained teacher prepares his/her general project of teaching and some means to implement it. We presume that this adaptation is accompanied by some changes (as minimal as they can be) which indicate the beginning consistency in their individual practices.

Therefore, we intend to describe the activity of the trainer as a procedure of changes through an analytical model that relies on both the ergonomic psychology and the didactics of mathematics.

3. **Development of an analysis model concerning the teacher's activity**

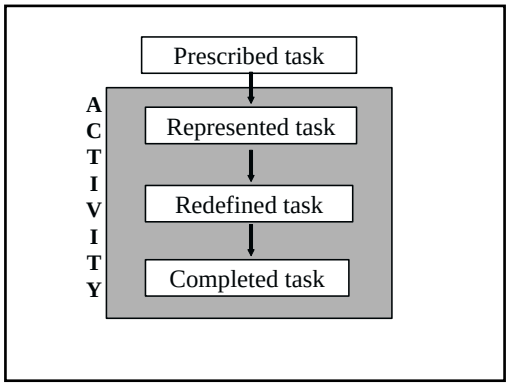
The starting point for the development of our analysis methodology is a scheme proposed by Jacques Leplat in " *Regards sur l'activité en situation de travail. Contribution à la psychologie ergonomique*" (Leplat, 1997, p.17). He describes the activity of the subject as a series of tasks and we resume a part of this scheme.

The task represented by the subject depends of course on the task, which it has been prescribed. This task corresponds to the question: "What do you think we expect you to do?"

However, the task prescribed is just a non-perfect model often defined only by its purpose. To operationalize this task, the subject must support the implied part inherent in this task. In doing so, he/she redefines the task according to his/her own characteristics and his/her own purposes.

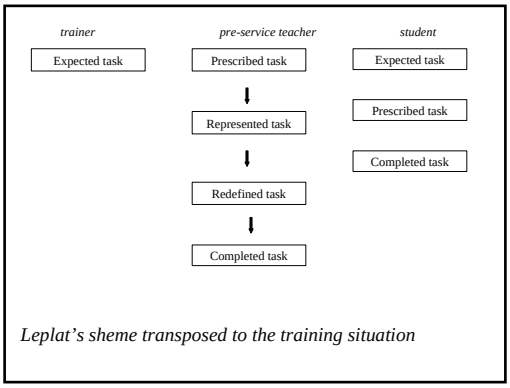
The completed task is the same one that actually corresponds to what the subject does when he/she performs the task.

As the subject is not only a simple performer of the "task prescribed", there is a divergence between these different types of tasks.



The scheme proposed by Leplat is general, by being focused on the task and not on the subject who has to execute it. We must change the scheme if we want it to adapt to our subject of study and to our problem. This adaptation is made up of three stages.

First stage: Transposition of Leplat's scheme to the training situation



Leplat's sheme transposed to the training situation

We transpose this scheme in the frame of a training situation by showing in parallel the activity of the trainer, that of the teacher and that of the student.

Second stage: focus of the activity on both the task and the subject

The scheme proposed by Leplat is based on the task. In order to solve the problem, which is ours, we seek to detect, for each monitored teacher and for each observed session, what is at the root of the divergences found between the original project and its implementation. That is why we choose to take into account the activity in spite of the task, that is to say, everything the teacher implements to perform this task.

This leads us to define three levels or positions of the teacher:

The representation of the task (prescribed): everything that the agent does in order to represent the task required.

The redefinition of the task (represented): everything that the agent does in order to redefine the task represented.

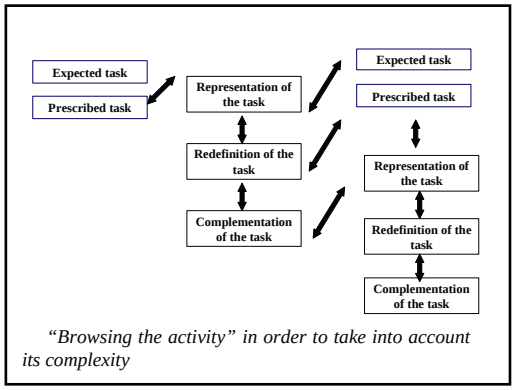
The completion of the task (redefined): everything that the agent does in order to achieve the task redefined.

The study of the teacher's activity will consist in describing the way the teacher, by moving from one position to another (some of them may take place simultaneously), prepares and

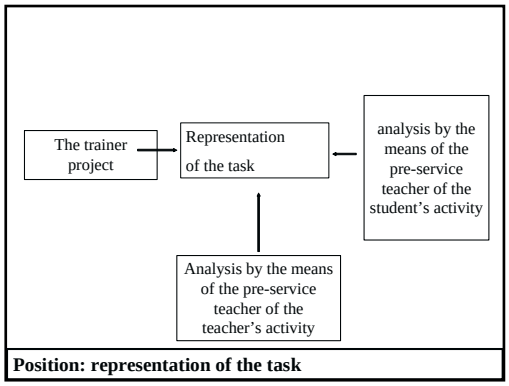
implements the session. The analysis of the meetings will consist in determining on which level (or position) the exchanges are focused.

Third stage: taking into account the complexity of the practices by a browsing of the activity

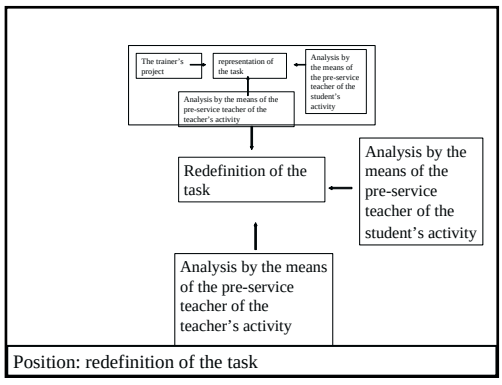
This final step is motivated by the will to take into account the complexity of the activity of the teacher. Our model presents three levels, which are not unrelated. For example, when the teacher redefines the task that will be his/her own, he/she questioned the way he represented the task (level upstream on our scheme) and at the same time, he/she anticipates the completion of the task (level located downstream on our sheme). Our intention consists in investigating the activity of the teacher by doing a "browsing" of these three levels. To browse a book means watching (quickly) each page to get an idea of the whole book. By the same token, we can study the activity of the teacher as a whole by taking into account the interactions between representation, redefinition and completion of the task. We study each of these levels one by one as if we were successively watching the "pages" of a book whilst keeping in mind the links that exist between them in this "piece of work".



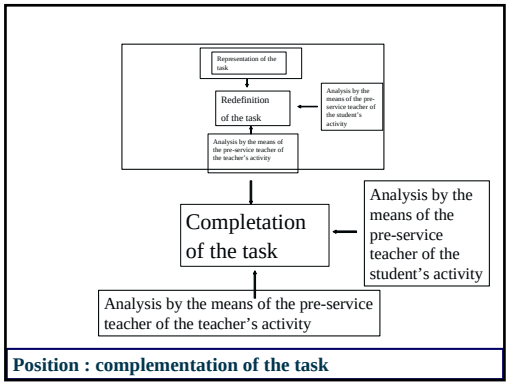
"Browsing the activity" in order to take into account its complexity



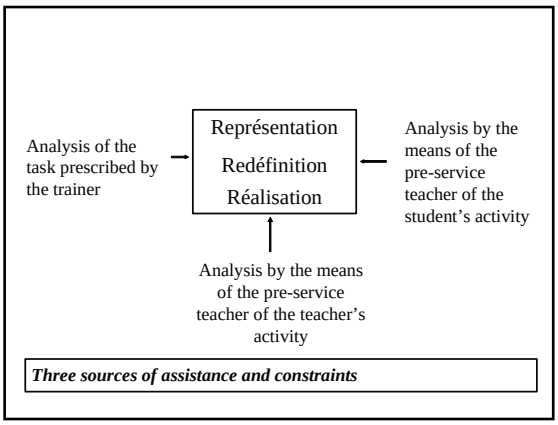
Position: representation of the task



Position: redefinition of the task



The methodology that we have developed to describe the activity of the teacher leads us to consider three sources of assistance and constraints: the analysis of the task prescribed by the trainer, the analysis of the activity of the teacher and the analysis of the activity of the student.



4. **Data analysis approach**

For each of the three teachers under evaluation, we analyzed five sessions. There is a trajectory for each subject: S1, S2, S3… that consists of a succession of moments during which he/she has been induced to develop, prepare and implement a teaching situation. Each session Sj is followed by an interview Ej. Our analysis model allows us to get some examples for contextualizing the changes procedure: C_{S1}, C_{S2}, C_{S3} In consideration of this "product" of the analysis model, we can deduce some characteristics, regularities. What is common and evolving in C_{S1}, C_{S2}, C_{S3}… can reflect the trajectory followed by each subject. Finally, by the means of the description of this path, we draw the consistency that gradually settles in the practices of the subject who is under evaluation. The "*ad hoc*" and deferred analysis of the interviews helps to highlight and characterize the consistency of the practices.

5. **Main obtained results**

Let us illustrate the main results of this research by analyzing the trajectory of one of the three teachers: Julie.

During the third series of workshops, the group of trainees has developed with the assistance of the trainer a sequence project regarding the introduction of the multiplication. Julie is responsible for conducting the first session. The original plan, which was developed during the preparation session, consists in introducing multiplicative writing as being a more economical writing of the reiterated addition. In accordance with this goal, the trainer advises

Julie to set up a communication situation: the children must order the cubes required in order to build towers of similar size and let their calculations apparent (eg: 15 +15 +15 +… ..). During a synthesis phase, Julie will have to introduce the sign "x" in order to simplify the writing way adopted by the children.

5.1.1. The teacher's activity described by the means of a procedure of changes.

The methodology that we have developed allows us to detect and describe how the procedure of changes is contextualized.

At the time she prepares the session, Julie thinks not to be able to manage the trainers' project due to physical constraints (to prepare the required cubes) and to difficulties related to the management of the class (to organize the orders and the displacements). Then, she decides to modify the original project. She eliminates the communication situation and provides the students with some cubes. She proposes three exercises from a school handbook ("CAP MATHS[1]") without taking into account the progression to which they subscribe. The activity consists of calculating the number of blocks needed to construct 8 towers of 5 cubes then 12 towers of 15 cubes, and finally two towers, one of 12 and one of 15 cubes.

The adjustments are not made without consequences on the task performed by the children. These ones build towers and then they just have to count the cubes they used in order to get the quantity of the cubes they need. Nothing compels them to write the calculations to be made. The goal that Julie has set herself is not consistent with the method suggested to the students. During the implementation, she does not anticipate the "trap" in which she is currently locked so that she is in trouble once more when she tries to institutionalize the multiplicative writing as a more economical writing.

Let us characterize this procedure for the three teacher's positions defined earlier: the representation of the required task, the redefinition of the represented task and the complementation of the redefined task. The divergence found after the completion of the task comes "upstream" from a divergence created during the redefinition of the task when Julie, by anticipating the difficulties she thought to meet at the time of her implementation, has chosen to deviate from the trainer's project. Julie redefines the task and locks herself in a procedure, which is growing slowly, by using two different sources (the school handbook and the trainer's project) without ensuring that the project is consistent according to the objectives set. The changes are linked and mutually reinforced to such an extent that Julie is put in difficulty during the complementation of the task.

5.1.2. A procedure that accounts for an embryonic consistency

The study of the procedure of changes allows to characterize the choices made by Julie and to report on the consistency of its practices.

From the preparation of the project until its implementation, the teacher trainee draws information to be guided in his/her choices, to measure the constraints to which he/she is subject and to invest a certain leeway for manoeuvre. The methodology we have developed to describe the teacher's activity leads us to consider three sources of assistance and constraints:

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[1] *Cap Maths CE1, Manuel de l'élève, Guide de l'enseignant, Hatier*

the analysis of the task prescribed by the trainer, *a priori* the analysis of both the teacher's activity and the student's activity.

The procedure of changes in which Julie is engaged was initiated by her own analysis *a priori* of the teacher's activity. Julie has set the objectives of her meeting and she pursues her goal. She does not hesitate to deviate from the task prescribed by the trainer. Everything occurs as if she took just a bit into account the activity of the students. At the time of the institutionalization, she asks students about mental calculations: *"We have counted by thirteens, so we have added the same number several times. So, do you know what operation was done in this case? "*For the children, this is an addition. Julie does not seem to be aware that they did not have to mobilize the knowledge she seeks to institutionalize.

5.1.3 Priorities connections among the three sources of assistance and constraints

Other sessions conducted by Julie were analyzed throughout the year of training. The intra-personal regularities highlighted through the Julie choices are helpful to define a certain profile. The difficulties the trainee feels to take into account students' learning characterize this profile. What guides the Julie choices before and during the meeting proceeds from her analysis of the activity of the teacher as far as we know at the moment. Julie has set the objectives of the meeting and she pursues her goal. If the students encounter difficulties during their learning, Julie exposes the knowledge covered by the meeting and institutionalizes it, by deviating, if necessary, from the documents on which she relied to prepare the meeting.

Some priority connections have therefore been installed between the three sources of assistance and constraints. The analysis of the teacher's activity shall prevail among these three sources. Julie determines her project upon both the knowledge to be institutionalized and an organization of the meeting in two phases (manipulation, institutionalization). This organization aims to provide her with some comfort by avoiding risk-taking, as she considers unnecessary. To carry out her project successfully, Julie does not hesitate to modify the documents on which she is based and to discard herself from institutional requirements. The analysis of the students' activity is not very relevant in the decisions taken by Julie (especially during the workshops).

Nevertheless, our analysis shows that during the first year of activity, the priorities connections among the three sources of assistance and constraints are no longer exactly the same as during the year of training. Changes in conditions for the exercise partly explain these variations. Julie takes even more into account the analysis she makes of the student's activity in order to build her projects of sequences. Therefore, her practices have evolved.

6. **Conclusion**

Everything occurs as if the practices of these three teachers were marked by predetermined elements that condition their activity, but also the development of their practices.

There are predetermined elements as the way each teacher takes into account and analyses the institutional requirements, the activity of the teacher and the activity of the students determine the changes procedure, which is inherent in the ownership of a situation.

In addition, these elements condition the development of the practices as the priorities connections that settle between these three sources of assistance and constraints as well as the analysis itself from the teacher could develop and affect the development of the practices.

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