A Collaborative Platform Supporting Knowledge Sharing and Problem Solving for Teacher Professional Development

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Abstract: The present paper proposes a platform to support teacher professional development. From a study of exchanges between teachers on Web forums we examine two facets of knowledge exchange, usual teaching practices and problem solving, and how they can be managed on a unique web platform. We use a task/method paradigm for knowledge elicitation about usual teaching practices, driven by the exchanges between teachers and capitalized into individual memories. For problem solving we use an IBIS-like approach (problem, solution, argument) and REX-like cards to structure the problem and solution description. The important problem of knowledge evaluation is treated with a three-level evaluation (opinion, usefulness and difficulty). The teacher's profile and its central role in connecting teachers is described. For knowledge classification, because a consensus is difficult in this domain, we propose a mixed approach between structured classification techniques (taxonomies) and unstructured techniques (folksonomies).

Introduction

In France, like in many countries all around the world, teacher professional development is one of the main concerns of authorities in charge of Education, and the case of young teachers is the most critical one. The first years of their career are a moment where they oscillate between pleasure and suffering, facing a "double learning": that of their pupils and that of their job. If professional development has for a long time been considered as a linear process where teachers apply external knowledge developed by researchers, latest researches and learning theories (Knight, 2002; Butler et al., 2004) have shown that this process is continuous mixing formal training and informal training through discussions with colleagues and reflection on teaching practices (Uwamariya & Mukamurera, 2005).

The lack of formal training urges teachers to compensate by participating in Communities of Practice either at a local level (inside their school or institution) or at a global level on the Web gathering together people with common practices, interests and purposes (Wenger, 1998; Koh & Kim, 2004). There, teachers exchange ideas and experiences, help each other to develop their skills and expertise and exchange to solve very contextual problems. In this community the dynamics of the exchanges favor innovation (creation of new methods and practices) thanks to debates and practice confrontation (Daele, 2006) (see Figure 1).

On one hand, at the local level, teachers exchange in a face-to-face relationship without computer mediation and avoiding capitalization of the knowledge created. On the other hand, at the global level, Web technologies like forums, blogs and wikis allow the accumulation of exchanges but in an unstructured and poorly contextualized way. Thus, knowledge created through discussions is hardly reusable. Moreover, the number of online forums in France where teachers talk about their practices limits knowledge creation, each one reinventing what has been discussed in another forum. This is due to the fact that the environments used are not specific for CoPs as stated by numerous works. Tools are often designed either to support sociability to the detriment of contextualized resource production and their reification, like Tapped In (Schlager & Fusco, 2004) or CoPe_it! (Karacapilidis & Tzagarakis, 2007), or to support resource accumulation to the detriment of sociability, like in doceNet (Brito Mirian et al., 2006). New works try to unify the two approaches, in an effective application of Web 2.0 principle, like Cloudworks (Conole et al., 2008) and TE-Cap (Lavoué & George, 2010), by supporting exchanges between members of the CoP and between CoPs and also capitalizing on these exchanges by placing them in the associated context. In these tools, a message on a subject, which can contain educational resources, a question about a difficulty, or a simple idea, is posted by a member and shared by the CoP allowing other members to react by posting messages, sharing resources … But separation is blurred between teaching practice description and requests from a teacher seeking help about a very contextual difficulty in his own practice. As in online forums, practice description is often given by a teacher A as an answer to a request for help from a teacher B and is actually an adaptation of the practice in the context of the described problem (what A would do in the situation of B) and can be different from the real practice of A in his own context (which can also be interesting to capitalize).

In fact, when we observe formal training in teachers training institutes (called IUFM in France) and lifelong training programs we can see two facets of knowledge construction. First, teachers have to observe other (experienced) teachers in different teaching contexts which allow them, by reflecting on the observed practices, to construct their own practice. They can then experiment their new practice in their own context

encountering difficulties and asking colleagues or experienced teachers for help. Following this observation, our work aims to provide CoPs of teachers with a unique Web platform which will support:

- knowledge elicitation (teaching practice) guided by the exchanges between teachers, capitalized into individual memories with the associated context;
- exchanges for problem solving, capitalizing problems (and their context) and solutions given by other teachers;
- Sociability and member participation with a Web 2.0 approach and a user profile management.

As a first stage in addressing this aim, we propose in the next part a description of the two facets in knowledge exchange and the models we use to take them into account.

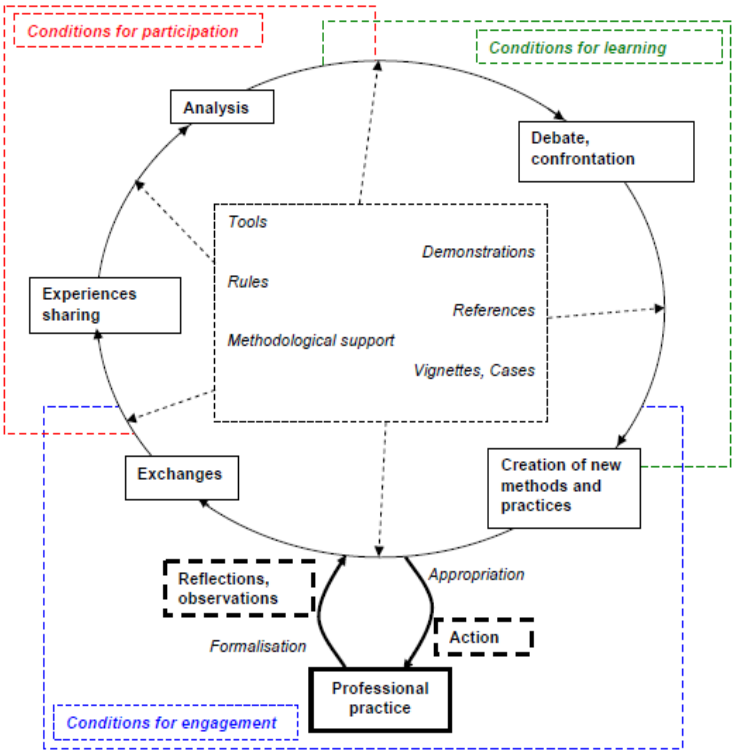

Figure 1. Daele Model of Teacher Professional Development through a CoP.

Two Facets in Knowledge Exchange

The first step of our work was to analyze online forums (http//forums-enseignants-du primaire.com is one of the most active), one of the tools mostly used in France by teachers to exchange on their practices, and cross the results with those observed in a teacher training institute. From this study we have classified the knowledge exchanged in two categories (see Table 1)

Table 1: Examples illustrating the two categories of the exchanged knowledge.

Usual teaching practices	Problem solving
"In your classroom, how do you proceed for diagnostic evaluations?" --- *"This is a post for CE1/CE2-level teachers. Can youtell me what you do in this kind of two-level class and give me good ideas to improve my practice?"* --- *"I need help to construct a time-table for a CE1-level class."* --- *"Next year I will have a double level class. I have never had this configuration before. How can I organize my teaching (schedule, group work ...)?"*	*"I have a CP-level class with 24 pupils. 9 of them have big difficulties (2 of them having a MS level). I began with the book "L'école des Albums" but those 9 pupils don't follow [...] Do you have an idea and help me?"* --- *"I have a pupil who seems to have no auditory memory. He can't neither remember the alphabet nor recite the first numbers list, [...] but he can [...]. What can I do for him?"* --- *"I have a CM1-level class. We've worked on numbers until 999999 with all the class and at the same time on numbers until 99999 with 3 pupils having difficulties*

---------- *"I have a four-level class (MS/GS/CP/CE1) and I would like to share my experience on this kind of class. How do you make your time-table? How do you manage readers and non-readers…?"*	*and until 9999 with one having more difficulties. But now I don't know how to manage the next activities because I have introduced big numbers (million). What can I do for the 4 pupils still having big difficulties on smaller numbers?"*

The first category refers to what we call "usual teaching practices". This refers to tasks having to be achieved by all the teachers and the methods used to achieve them. It depends on the global context of the class (level) but it doesn't refer to a very particular situation. A teacher, often a young teacher, wants to know what others do in a given context (same class level). This reflects a need to share practices and to have reference teaching practices to analyze and from which to construct their own practice (Perrenoud, 1999).

The second category refers to a problem solving support. A teacher encounters a very specific problem depending on the global context of the class but also particularities like particular pupils (handicapped pupils, pupils with specific difficulties …). It can also refer to a particular activity constructed by the teacher, the use of a particular resource …

When a teacher wants to know what others do in their class (similar to his own class) in their day-to-day practice he is not interested in very specific problems. On the other hand when a teacher encounters a problem in his practice, this is always in a particular situation and he needs a specific answer. So our postulate is that these two facets can't be treated at the same level.

Usual Teaching Practices: The Task/Method Paradigm and an Exchange Driven Acquisition

In This Module Of our platform, we want to allow a teacher to construct a personal knowledge memory containing descriptions of his practices. In this process it's not only important to know what he does but also his reasoning. To represent the reasoning model (how a task can be performed), we used the Task/Method paradigm (Camilleri, 2003) where a task (what the teacher have to do) can be performed by different methods (a method describing one way of performing a task) giving a decomposition of the task into sub-tasks. A method represents the know-how which it's possible to implement in order to achieve the task. A method is characterized by conditions that must be satisfied to apply the method, controls giving the achievement order of the sub-tasks and a sub-task set. In this paradigm, a special type of tasks is available: terminal tasks. Terminal tasks are directly executable tasks requiring no decomposition (see Figure 2).

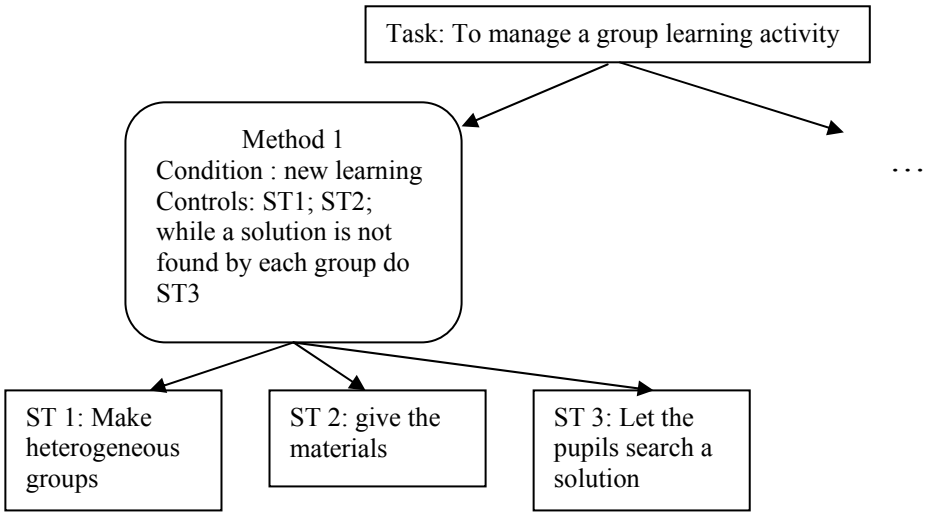

Figure 2. Example on Task/Method Decomposition (ST Means Subtask).

In knowledge management, knowledge acquisition is realized through discussions (interviews) between a knowledge engineer and experts. In our case if there are experienced teachers there is no representative expert. Each teacher have developed his own know-how which can be different from another teacher but equally effective. There is often no consensus on a teaching method. So our idea is based on knowledge acquisition from each teacher using the platform, storing it in a personal knowledge memory. Since interviews can't be done we use an exchange driven process. Starting from a reference list of basic tasks (high level tasks) each teacher have to achieve, the task/method decomposition can be started by a teacher wanting to

share his practice and is refined through requests from other teachers (see Figure 3). It can be a request with a new condition getting to describe a new method. For example, in the case described on Figure 2, a teacher can ask "How do you manage a group learning activity in the case of reinvestment of an already learned knowledge?". A new method must be described with the new condition (reinvestment of a learned knowledge). It can also be a request for more details on a method or a terminal task. For example, a teacher can ask "how do you make the heterogeneous groups?". The method or the terminal task must be refined.

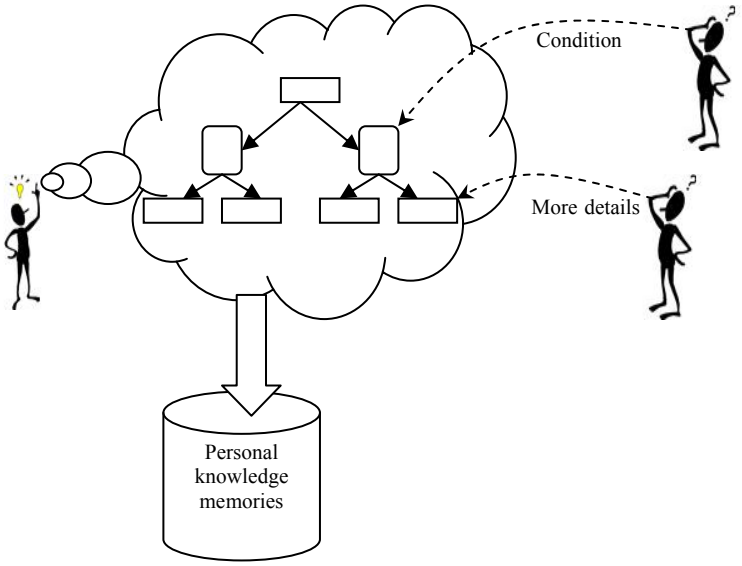

Figure 3. An Exchange Driven Knowledge Acquisition.

If a teacher ask for details, describing an unusual situation, it can't be managed in this part and enter in a problem solving process.

Problem Solving: The IBIS Approach

In this part, a problem refers to a difficulty encountered by a teacher facing an unusual situation in a very precise context and for which he needs help (see examples in Table 1). When we look at the answers on the forum we find different solutions given by different teachers but also arguments for or against a given solution. The exchange (problem, solutions and arguments) can also generate a new question referring to a new difficulty. For modeling those exchanges we use the IBIS method (Conklin et al., 1991) approach (which is traditionally used for capturing Design Rationale) with three elements: problem (defined by the context of the situation, particularly the task during which the problem occurs, and a question specifying the help needed), solution and argument.

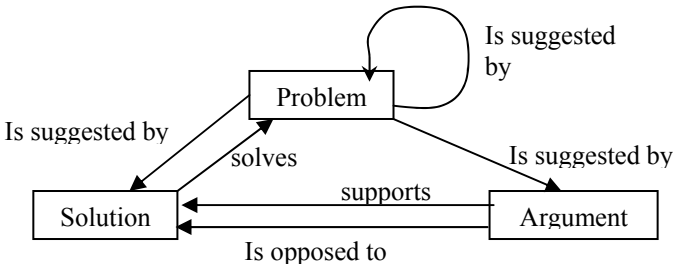

Figure 4. General Model of Problem Solving.

When a teacher describes a problem, he writes a problem card giving several characteristics:

- The task during which the problem was encountered. For example: "*Implementation of a teaching sequence – Collaborative working phase*". The first task level comes from the reference list of tasks mentioned in the previous part. Subtasks can be proposed (coming from subtasks already given for others problems or coming from the personal knowledge memories) and new subtasks can be entered.
- The type of the problem. For example: "*problem of discipline*". Types of problems are proposed coming from problems already defined and referring to the same task. A new type can also be defined.

- The context during which the problem occurs. It's different from the working context of the teacher which is defined in his profile as we will see later. For example: "*The children were very excited, speaking loudly, moving from one group to another. After one hour during which I was often shouting, I stopped the activity and ask for the solutions found. But there were no interesting results and I have to do it again later!"*
- The question that specifies the help needed. For example: "*If I do it again what can I do for more concentration of my pupils?"*
- Tags.

When another teacher wants to propose a solution, he can ask the problem author for more details. It could be done through a discussion between all the teachers like in online forums but it's long and difficult for a third teacher to read all the exchange and have a good idea of the problem and its solution. So we choose another way using a solution card and separate asynchronous discussions between the problem author and solution authors. The solution card contains a description of the solution, an arguments supporting it and recommendations to success in the solution practical use (especially for young teachers). This approach is inspired by the REX method (Malvache et al., 1993) used for knowledge capitalization and using knowledge card. When one ask for more details (problem author or solution author) the corresponding card is modified. The solution card is visible only by its author and the problem author until the description is clear for the problem author. When the discussion is closed, the solution card becomes visible to everyone and arguments can be given.

Knowledge Evaluation and Feedback

An important point is the knowledge evaluation process. Our choice was to use a three-level evaluation and rating:

- The opinion about a method (in the personal knowledge memory) or a problem solution which is important to identify communities having similar teaching methods or pedagogical approaches. A mark (from 0 to 4) can be given with an argument describing the reason of such a mark.
- The usefulness of a method or a problem solution. When a teacher try to use a method or a solution he gives a feedback with : a mark (from 0 to 4), an argument describing the reason of such a mark, a description about how he has applied and perhaps adapted the method/solution in his own class, and advices for a better use of the method/solution. This evaluation is very important, especially when it comes from young teachers.
- The difficulty to use the method/solution in the practice. A mark (from 0 to 4) is given when a teacher has used it and details about the difficult steps are given.

The usefulness and difficulty evaluations can be crossed with the teacher profile to know more about it for a given level of experience or class type.

Teacher Profile for Connecting People

The teacher profile is composed of:

- Identification data for accessing the platform (login, password, …)
- Pseudo: the fear to be judged is important in this community so anonymity is crucial.
- Age, sex
- Certifications
- Working context (see Figure 5): characteristics of the current class (level, number of pupils, standard or specialized class, presence of handicapped pupils), characteristics of the school (located in city center, suburbs, rural area, special locations like "violence area", number of classes), characteristics of the position (full-time, part-time, …)
- Past experiences: different working contexts
- Books used : this is an indicator about the pedagogical profile of the teacher since a book generally refers to a specific pedagogical method
- Centers of interest: tasks about which the teacher wants to be kept informed in priority
- Statistics about the teacher activity on the platform: number of connections, last connection, number of problems/solutions published, number of evaluations given …

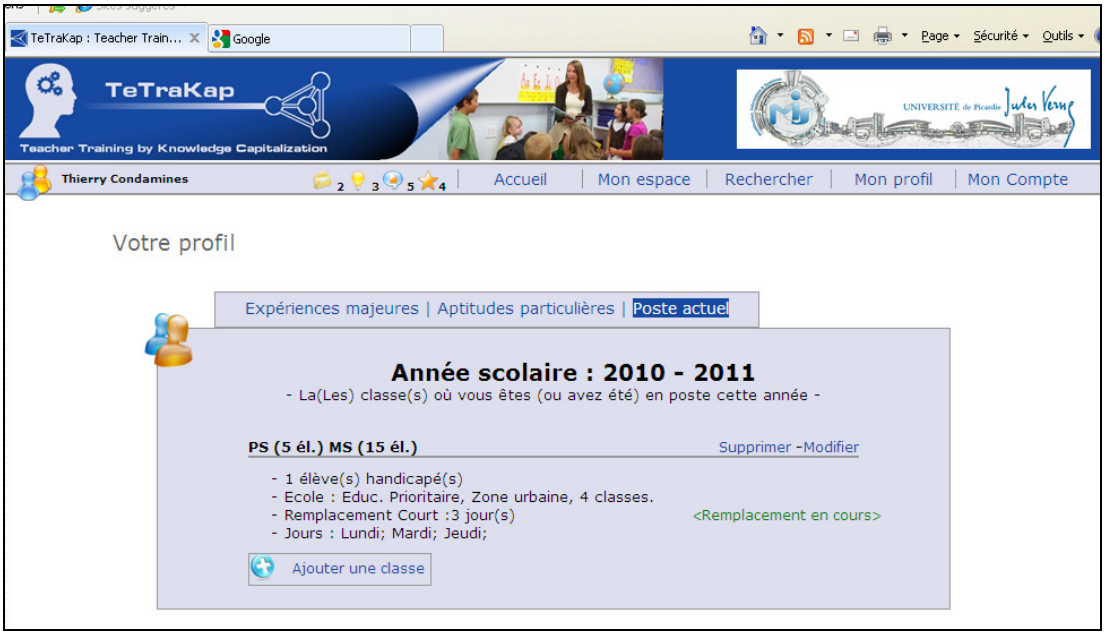

Figure 5. A Profile Element: Actual Working Context.

This profile is very important because it gives a better understanding of methods and problems but also to connect people. Knowledge broadcasting is a well-known problem and Van Heijst et al. (1996) gives different ways of collecting and broadcasting knowledge. When a problem is put in the system, its author generally needs help quite quickly. So to avoid passivity we choose an active broadcast (push way): when a problem card is written, it's published on the home page of teachers who are likely to give an appropriate help, that is people who have a sufficient experience in/near the same working context. In the same way, when solutions cards are published, the problem and its solution appear on the home page of teachers having quoted the task where the problem occurs as a center of interest.

Knowledge Classification

If taxonomies and ontologies are structured conceptual representations often used in knowledge indexing systems, they require a consensus between experts which is long and expensive to obtain and not always comprehensible by novices. When we observe the literature in the education field we can see that such a consensus is quite impossible. Moreover the evolution in time of these models is difficult to manage and is the subject of lots of recent researches. The other indexing system, the folksonomies, is less structuring but is based on the community activity and allows each user (knowledge as well as experts) to enrich the descriptions.

Our approach mixes the two systems, taxonomies and folksonomies. A general task classification (up to 2 levels) of high level tasks was constructed from official documents (Ministry of Education) on teachers' skills and interviews of teachers about their usual tasks. Subtasks can be added by each user through his personal memory construction or problem description. In addition users can add tags.

In addition, in a search, subjects are filtered by the teacher profile (working context) with a possible extension of the search space to other contexts.

Implementation and First Results

Our approach is implemented on a Web platform called TeTraKap (for Teacher Training by Knowledge capitalization) using PHP+MySQL technologies. The tests were realized with a group of 10 teachers from primary school with different level of experience (from novice to expert). Note that the technology was still under development during the time of study; therefore the results are mainly indicative.

The first criteria we used to know if the platform matches teachers' real needs were usability and sociability of the environment, level of knowledge sharing and adoption of the environment by users.

The community is of course too small to induce high interactions. But observing the activity on the platform and knowledge exchanged shows a progressive refinement of practice description (of experienced teachers) thanks to requests for details coming from novices. Moreover a novice can focus on an experienced teacher having a similar context and systematically asks him for help on specific problems (using the form for practice refinement). This effect shows that we must better think the separation between the two parts.

With interviews of teachers we could have details which can't be observed directly on the platform. If some tasks are not detailed because they are not crucial, even for young teachers, some of them are not because teachers need to exchange documents, timetables, photos of the classroom … this functionality is also important to help tacit knowledge elicitation, through videos for example. Concerning the interface, the "facebook-like" interface (see Figure 6) with profiles, practices and problems suggestions filtered according to the user profile seems to be appreciated. But the use of forms for practice elicitation is too heavy and not adapted. A graphical one could be a solution but this problem is still under study because the teachers don't seem to be familiar with some graphical tools presented.

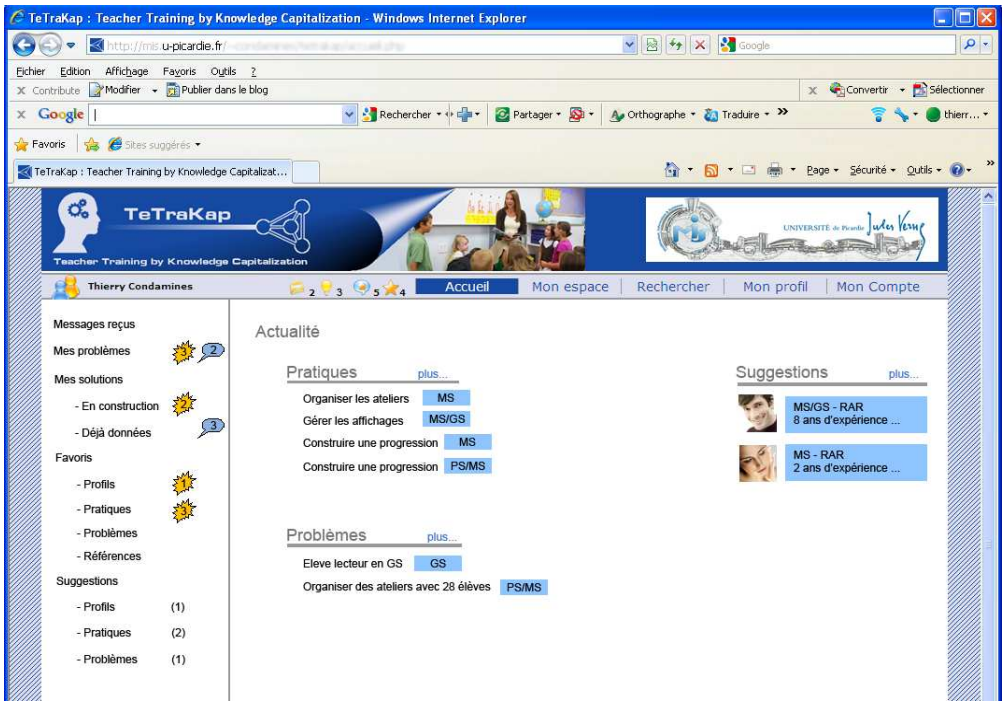

Figure 6. A Teacher Home Page.

Discussion and Further Work

Knowledge Co-construction

In this paper, we have shown a double approach of knowledge sharing for professional development in a community of practice linking up practice description and knowledge solving on a unique platform. This approach corresponds to a real and important request from teachers, especially young teachers or teachers changing context. Constructing your own practice by a try and error process is not only a long and difficult way for professional development but also a brake for innovation. In our approach, by connecting people with similar professional contexts, we will favor knowledge co-construction and innovation, allowing teachers to construct and improve their own practice by analyzing different existing practices. If the first results are encouraging the tests must be extended to a bigger population to evaluate the effectiveness of knowledge classification and the way people are connected, especially for problem solving. In this part, problems are indexed by the task/subtask where they occur and the problem type is given by the user. It would be interesting to use a high level problem taxonomy, as for the tasks, for better structuring. It would also be interesting to use a graphical interface, especially for the task/method decomposition of practices. But it's delicate because teachers, especially in primary school, are often reticent to use and construct computerized diagrams.

Bridging the Gap between Teachers' Practices and Educational Policies

A future work about our platform is to give functionalities to analyze the practices and problems. We believe that it could give indicators to adapt teachers training policies with better reactivity and an inventory of real teaching practices. On the other way it would be interesting to make it possible to education managers to give a knowledge "institutional evaluation" (but keeping anonymity, crucial for teacher participation). This 4th evaluation could give a return to teachers about the appropriateness of their practices to educational policies.

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