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What training is necessary for the mentors of trainee teachers of mathematics ?

Abstract :
In this paper, we shall try to define the different dimensions of the function called «pedagogical counsellor ». This teacher, often very experienced, is chosen from a list proposed by the Inspector of mathematics teaching. His role is to help the novice teacher when he is for the first time in front of pupils.
Through these teachers' talks about their trainees' practices, we shall try to discover their own representations of a mathematics teacher's work.
Then we shall show how their function of counsellor is perceived as a tension between what is institutionally expected and their quest of a personal identity.
Afterwards we shall question ourself about the epistemological posture they have in front of knowledge : mathematical, didactical, psychological knowledge.
Lastly, we shall study an example of training of these expert teachers.

Introduction

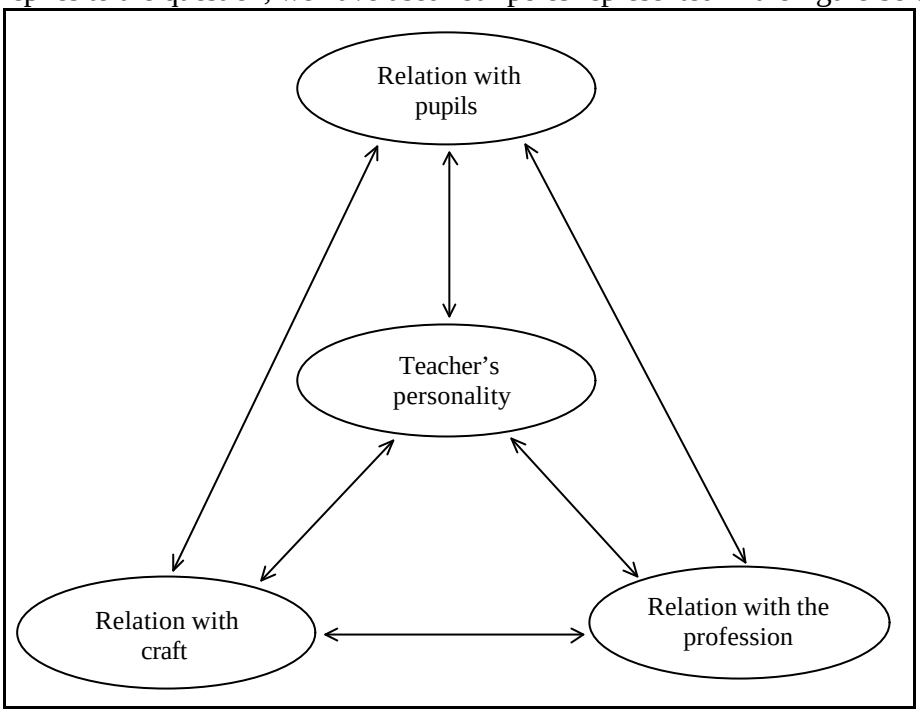
We are going to explain how the training of second degree school teachers is organized in France. After three years at university during which they have trained for a degree, students devote a year to the preparation of the contents of recruitment for secondary education teachers, the CAPES. In case of success, they will have to undertake a professional training year to acquire or not their certification as professors. They will then be appointed to a position. These two years (preparation of the CAPES and professional training) are placed under the responsability of the IUFM (Institut Universitaire de Formation des Maîtres).

Consider the organization of the professional training year. It is organized in this way :
1) Two training periods in classes:
- the first one is labelled « in responsibility »: the trainee teacher alone, for four or six hours a week (in a class). He is under an experienced teachers's supervision. This one visits the trainee and vice versa.
- the second one is labelled « accompanied practice », about fourty hours, most often in a cycle different from the preceding training course, in the class the teacher remains with the trainee.
2) Training in the institute, itself separated into three components:
- « disciplinary training », centered on disciplinary notions and the question of their transmission,
- « common training » that gathers around transverse thematics trainee teachers (primary and secondary),
- « general training » that deals with questions of education: child and adolescent development, violence in school, ...
3) writing a professional essay.
In this text, we will deal with teachers in charge of trainees during the two placements in classes.

I. How do mentors characterize the way their trainees function?

We have chosen the detour of the mentors' speech about theirs trainees' practices to try to identify through this speech organizing elements of the representation that counselors have about their own practices.
During the first day of a mentor training session, that we will study in detail later, we asked them to characterize what is a « succesfull » trainee and a « failing » trainee.

To sort out replies to the question, we have used four poles represented in the figure below.



By «relation with pupils », we mean all that relates to the relation between teacher and pupils. By «relation with craft », we mean the technical mastery of the transmission of knowledge and by « relation with the profession », we mean links betweeen teacher and the institutions in which he evolves, formed by his colleagues and the administration he depends on.

We exemplify using extracts of posters made up to reply to the question (see below).

Assertions are more or less equitably distributed between the four components (a little less for the relation with the profession).
Each of the four components can be built in several organizations according to the subjects. Here, our objective is not to give a typology of mathematics teachers by dividing up each component and trying all the different possible combinations. We have just tried to show the main structures of organization in the idea of identity for teachers.

	« succesfull » trainee	« failing » trainee
Relation with pupils	* he comes down to the pupils' level while keeping a certain distance * he is interested in pupils' personality * he is able to use the equipment (board, ...)	* he is not able to pay attention to the pupils * he does not master his pupils' behaviour * lack of communication with pupils * he does not know how to place pupils in the classroom * no respect of pupils' personality
Relation with craft	* good adaptation to the pupils' level * he integrates the lesson in a continuity of course * mastery of the contents and objectives of curriculum * he is able to balance theorical courses and examples	* over estimation of exercices * « he flies too high, he flies too low » * he thinks that knowledge exempts him from preparation for the lesson
Relation with the profession	* he tries to be part of the team of teachers in the school * he has conversation with other teachers * he pays attention to the advice while defending his ideas * he feels like teaching	* he does not accept the older generation * he avoids other teachers * he is often late (for the lesson and for giving back exercises after marking) * he does his job amateurishly
Trainee's personnalit	* he is motivated * he takes initiative	* he is too timid * he has no charisma

y	* he questions himself about his practices * he has evolved all along the year * he speaks clearly	* he is too sure of himself * he considers that discipline is not a good thing

How will these structures work in the interaction between trainee and mentor ? Will the function of mentor, superposed on the function of teacher, go in one particular directions ?

II. Mentor : a function in tension between aspiring to one's own identity and standardizing

To initialize our reflexion, we had the following question : what logic(s) of interaction organize the relationship between a mentor and his trainee ? We have to bring out three logics : the logic of conformity, the logic of professional abilities and the logic of professional identity. We mean by logic of conformity a relation which will be organized to produce a standard teacher. A logic of professional abilities will try to change the trainee in a teaching technician while the objective of the logic of professional identity is the chosen and well thought out affiliation to a profession.
We have crossed the three logics with the different possibilities of interaction between a mentor and trainee : mathematics contents, management of the class, the didactic problems met by the trainee, the trainee's participation to the pedagogical team of teachers in the school and last the report that the mentor makes about his trainee's activity.
I give here for example three situations illustrating the three logics in one didactic problem. We are in the following situation : after a trainee's lesson about the sum of vectors $u + v$, u represented by the point (A, B) and v by (C, D), the mentor tells the trainee
* In ten seconds, you said to the pupils two contradictory things : « you have to construct another vector » and « you have to construct the same vector ». It is absolutely necessary to avoid that. You must say : « We must construct v from B », you show them again once or twice and you give another exercise in which you change A, B, C, D to X, Y, Z, T.
* To construct the sum u + v, I think that one mathematical tool is lacking: the notion of « vector representing ». The curriculum does not allow you to talk about the relation of equivalence in the set of couple of points in P^2, but it is not forbidden to use the fact that a vector is a set of equipollent couple of points.
* Don't you think that a notion was missing in the beginning of your lesson. This notion would enable you to avoid telling about the sum $u + v$ « you have to construct another vector » and, ten seconds later, « you have to construct the same vector »? Is there not a word, linked with the notion of «vectorial space », that would allow you to avoid this contradiction?

We asked a group of mentors in the Académie of CAEN to give these 15 situations two suffixes:
- a « degree of reality » if they consider them as likely,
- a « degree of desirability » if they consider them as a thing they would like to do.
This questionnaire was given at the end of the first day of the training evoked above.

Quantitative exploitation of the answers

The two suffixes we asked to give to each situation had a value between 1 (not at all true to reality or not at all desirable) and 5 (quite true to reality or very desirable). For each situation, we made the average of the score obtained in each of the two points of view then we calculated the difference of the averages « desirability » - « reality ».
The results, obtained from about fifty questionnaires given back, should be taken with the greatest caution, considering the number of answers, but can, nevertheless, provide us with interesting elements of thought. Here is the table of the differences of the average scores.

	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10	s11	s12	s13	s14	s15
reality	1,42	2,75	3,83	3,08	2,18	3,08	3,17	3,42	2,5	2,08	3,17	2,08	4	2,75	2,5
desirability	1,09	3,27	4,09	2,73	2,73	4,09	2,55	3,36	2,18	1,36	3	3,36	3,55	3,55	3,73

S1, S2, S3 are situations about mathematics contents, S4, S5, S6 about management of the class, S7, S8, S9 about didactic problems, S10, S11, S12 about pedagogical team and S13, S14 and S15 about reports. S1, S4, S7, S10 and S13 are illustrative of the logic of conformity, S2, S5, S8, S11 and S14 for the logic of professional abilities and the other situations for the logic of professional identity.

	Logic of conformity	Loic of professional abilities	Logic of professional identity
Mathematics contents	S1 -0,33	S2 0,52	S3 0,26
Management of the class	S4 -0,36	S5 0,55	S6 1,01
Didactic problems	S7 -0,62	S8 -0,05	S9 -0,32
Pedagogical teachers team	S10 -0,72	S11 -0,17	S12 1,28
Reports about trainee's activity	S13 -0,45	S14 0,79	S15 1,23

A possible interpretation of the results of quantitative analysis

In the first table, giving the averages of each situation according to the points of view, we put in grey the squares in which the scores were above 3, the average score. Four situations appear desirable **and** real S13 (logic 1[1]), S8 (logic 2), S6 and S3 (logic 3).

In the second table, we have ringed the phenomena that seem to be striking :

- all the illustrative situations of the logic of conformity seem to be rejected, that is to say that they are considered much less desirable than real.

  So the situations which could appear as recipes that everyone uses (those of the first column) are, on average, considered less desirable than real, even if one of them (S13) has a high score from the point of view of reality and that S7 and S4 do not have too inconsiderable scores.

- Three of the five illustrative situations of the professional identity logic have a score a little higher from the point of view of « desirability » than from the point of view of « reality ».

  Moreover, four of the situations of the third column have higher scores than the average, the best scores being those of S6 and S3. We could see here a sort of attraction toward some situations of interaction mentor-trainee in a logic of construction of the professional identity of trainee, even if we know that, in practice, the situations influenced by the concern for the logic of conformity weigh heavily.

- The three situations centered on the didactic management of teaching problems are rejected, with the same meaning as above.

  And yet, let us notice that the situations S7 and S8 have scores higher than S3. We interpret this as the expression of a didactic uneasiness among the mentors that have answered, divided between a sort of pragmatism (S7 : I show you how it works), a little more technical position (S8 : I give you the mathematic key), but not daring to tackle the teaching problem set under the epistemologic angle (S9). The presence, in the exposition of the situation, of the expression «vectorial space » has probably a great influence on the answers inasmuch as this vocabulary is now excluded from the official instructions.

[1] Logic 1 will be used for the logic of conformity, logic 2 for the logic of professional abilities and logic 3 for the one of professional identity.

Though it is brief, this analysis reveals, in the function of a mentor, a real tension between the conformity and the conquest of professional identity.

III. Epistemologic position of the mentor in relation to the knowledge at stake in the class

The phenomenon we have noticed before urges us to go further about the form of the relations that will appear between a trainee and his mentor.

Several forms of relation can be identified

- the relation of authority
- a connection between an initiator and an initiated person
- relation between master and novice
- the relation colleague-colleague
- the relation a well informed professionnal-a beginner.

The situations proposed as illustrations of the logic of conformity often lead to the development of a relation of authority

> when a trainee « is not successfull », « we tend to direct and we try to stop things getting any worse for the pupils », « we impose our help tactfully », and « if unwillingness : S.O.S ». We can also « call the rebellious pupils in front of the group to discuss their problems » and even « intervene in class if necessary ».

or initiator-initiated:

> « we integrate the trainee in a staff, disciplinary or not », « we make him be part of APMEP[2] »

The logic of the professional abilities will appear in interactions in which the connections between trainee and mentor will be, most of the time, a relation between master and novice, based on « showing how to do ».

> « To advise, we use our professional experience », « our own courses ». So we can « compare the reactions and the results of the pupils of the mentor and those of the trainee ».

The situations S2, S5, S8 and S11 illustrate this type of relationship : the mentor wants to make the trainee competent, ie efficient, giving him the solution of the problems he faces, like the organisation of the mathematics contents, management of the class, the didactic problems, ...

Others mentors seem to have another type of relation with their trainee: a connection between colleague that we can refer, in a certain way, to the logic of professional abilities. For instance, after watching a video-recording of one trainee's lesson, one of the mentor stated, before any discussion: « After watching the video, I want to say that what I have seen is good ». Can't we see here a defense of his own professional competence that risks being handled roughly by the critical views he will have to express on what he has seen which may be quite similar to his own practice. The critical exercise is not understood here as allowing to distance onself to be able to analyse but as an evaluation exercise that aims at judging the whole procedure.

We can measure the efforts that have to be made in order to go beyond the logic of professional abilities and to develop the logic of professional identity. We can measure the efforts that have to be made in order to go beyond connections between master and novice, or from colleague-colleague, to the relationship between a well informed professional and a beginnner. We had built the situations S3, S6, S9, S12 and S15 to show the questioning dimension of this process, implying a distance of the trainee in relation to his practice.

We can find, in the speech of the mentors some signs of this ambition:

> to « urge the trainee to question himself », « we can rely on the theoretical frame of didactics ». The frame of reference is clearly made explicit and the will of distancing of practice is made by the theorical detour. The situation is more

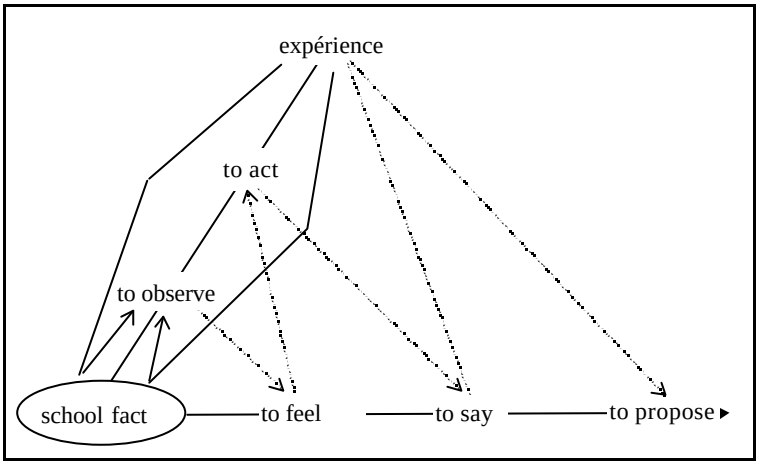
[2] APMEP is a mathematics teachers national association

ambiguous in the following case : « we can use some articles about pedagogical experiences (publications of the IREM[3]) ». Will these experiences be regarded as a testimony, or will the mentor take care not to forget the environment in which they were elaborated ?

The issue at stake here is to know what epistemological approach of the knowledge at stake in the class will be proposed to the trainee through the interaction mentor-trainee. And then the question of the epistemological position of the mentor in relation to this knowledge. By « knowledge at stake in a class », we mean the mathematical knowledge taught during the visit of the mentor, but also knowledge produced by didactic research, linked to mathematics education in general or to the specific knowledge of the day. We also include in this notion the « experiencial knowledge » the teacher develops in his class, most of the time without realizing it.

In front of the professional problems formulated by their trainee, most of the mentors answer immediately. They try much more rarely to take time to reflect with their trainee. Here are a few answers to the question : « what do you do with your trainee ? » : « discussion, exchange », « on precise points, by giving a piece of advice », « from concrete situations watched in class, to give a positive or negative criticism » (compared with « our own lessons »). But we can become « directive », thinking of « limitating the damage for the pupils ». I think we can envisage the working of mentor as follows : so as to help the trainee, the mentor will try, after feeling some gaps in relation to his own reactions in his daily practice, to mention it to the trainee to propose him answers, even to convince him to adopt them, though he often does not admit it!

Here is a diagram of this position below.



Epistemologic position of mentor

It is clear that this behaviour, which is understandable, does not fit the conceptions put forward by the official texts and by the IUFM, that makes of problem-solving, by the one that is learning, the main engine of their apprenticeship.

Then the question of training for the mentor is raised : can their practice as counsellors and the views of the IUFM be brought closer ?

IV. A maths mentor training

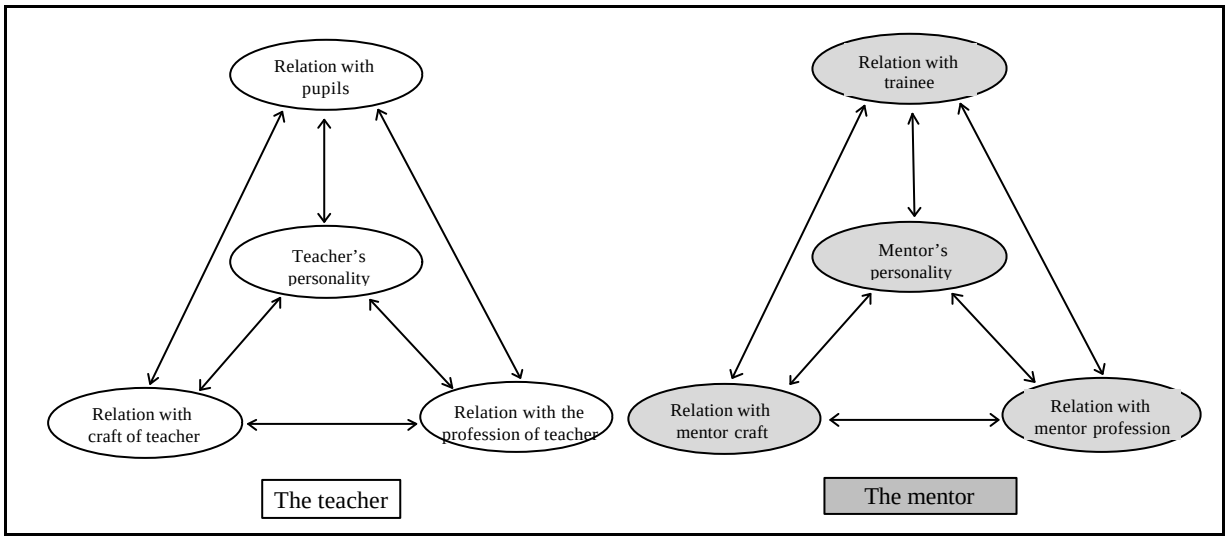
Description of an action lead in 97-98

At the beginning of the school year 97-98, I was asked by the math inspector and the IUFM to organize some meetings with mathematics mentors in charge of the trainees all through the year.

[3] IREM : Institute of Researche on Mathematics Education

150 interested math teachers took part in those meetings : two days (nov 97, march 98) near their school in small centers (about 30-40 teachers in each) and one day (may 98) in the IUFM center in Caen.
The first day was devoted to an attempted explanation of the mentor function, around the answers that they gave to three questions asked by the teachers of IUFM and an exercise of analysis about a video-recording. The second day was devoted to observation and interview. The theme of the third day was the pupils mathematics activity. Let us detail the organisation of these days.
First day
The morning was organised around three questions initializing a reflection on the role of mentor
Q1 : Try to characterize what « a successfull trainee » is and what « a failing trainee » is.
Q2 : For each of these two cases, try to answer the following questions :
a) in relation to what did you adopt this position?
b) what do you do?
Q3: As a mentor,
a) what can I rely on ?
b) what do I lack ?
In the afternoon : analysis of a video-recording. You are the mentor of this trainee, you will have to speak with him after the class, what will you say to him?
The answers we expected to question Q2b were in terms of action and those to the Q3a in terms of cognitive tools.
Second day
- The morning was devoted to the building of a grid to observe trainees,
- the afternoon, to make the participant work on the interview. We chose to give them the transcriptions of two conversations mentor/trainee so that they could define their characteristics.
Third day
One of the main themes tackled after the viewing of the recorded session (first day) was the notion of mathematics activity : when can we say that pupils are « doing mathematics »? This was the main theme of the day.

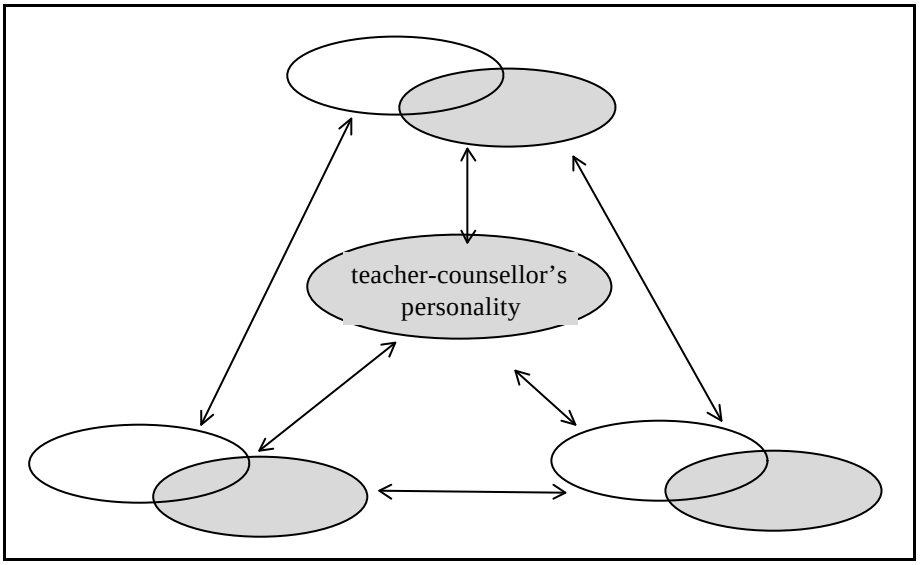
Analysis of this training through a proposal of a model
The mentor function is based on two aspects : the teacher and the counsellor. Let us consider again the model proposed in II, we obtain the following schemas below.



These two aspects are present in the same person, which we can see through expressions like « in our personal experience », « in our own courses ». This is what we want to mean in the following schema (see diagram below).

Our options in relation to apprenticeship make us favour the process that aims at the development of the professional identity (cf II). In another paper, we used the word « formalisation » and the expression « didactic of questions » to characterize this logic, in contrast with « formatation » and « didactic of examples » to characterize the logic of conformity and « formulation »and « didactic of prescription » to characterize the logic of professional abilities.

For us, the first day comes within the framework of the modalities aiming at the formalisation, and mainly adressed to « the relation with the trainee », as mentor, and « the relation with the mentor profession », inasmuch as, for the first time, they could have a meeting as mentor. Nevertheless, it is obvious that the remark already quoted (« I want to say that what I have just seen is good! ») shows that we touch here the teacher's personality that live with the mentor's one.



The double person : teacher-counsellor

The second day was centered on the mentor and more specifically on the dimensions « relation with the mentor craft » and « relation with the trainee » (build observation tools, study transcriptions of interviews). The modalities chosen aimed at the formalisation but we notice that many participants would have liked to obtain some ready-made tools (« give us the tables you use », « what is the good scenario of an interview? »), expecting to formulate for them what should be their professional competence, in the dynamics of a didactic of prescription. But it is clear that we reached too, through the exercises we proposed, the mentor himself, working on subjects that refered directly to his own practice with the trainees : how and with what does he observe them ? How does he conduct his interviews after visits and when they prepare lessons with his trainee?...

For the third day, we had chosen a theme particulary discussed in the course of the first day and at the core of everybody's practice (pupils' activity) but a way of leading fewer implying : we wanted, by giving information, to adress as a priority the teacher and not only the mentor. The speech could disconcert some participants, it was centered on the pupils with social and /or cognitive problems, which enables us to stress more easily the characteristics of the notion of pupils'activity in relation to a given disciplinary content. The afternoon

workshops showed some practices which can qualify as being innovatory. This day was judged positively by all the people who were there.

V. Conclusion

The previous analysis makes apparent a distortion between the aims of the leaders of those days and the implicit expectations of the participants : they are maths teachers first, before being mentors in charge of trainee teachers. It is in a dynamics of a didactic based on examples or prescriptions that they generally expect an improvement of their abilities, those of the teacher having priority. Can we suppose that, for most of them, this improvement will improve their abilities as mentor? Then we can question the model of apprenticeship they seem to have and find there an explanation for the gap that the trainees notice between what they are told in the IUFM and what they experience in schools.

To end, I'd like to note a double phenomenon. « Can I change someone who is 25 years old? » asked a mentor. Discouragement, defeatism, deontological questioning? Whatever it may be, this is a question that concerns the personalities : the one of the trainee and the one of the mentor. And we, in charge of the training of the mentors, can we make mentors change knowing that some of them have been teachers for over 25 years and mentors for over 15 years?