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11. QUALITATIVE AND QUANTITATIVE STUDIES ABOUT MATHEMATICS TEACHERS IN FRANCE

INTRODUCTION

The below research fits well into the research problem of this book and into the theoretical framework of the double approach, yet it presents a particularity which distinguishes it from the other works: it is based mainly on a quantitative study, carried out on a large scale, about the practices of high school mathematics teachers.

The aim of this research is also within the scope of the common objective of identifying regularities and irregularities in the practices of teachers, teaching mathematics in high school, but this time the aim is to do so on a large scale, which is not without effect on the analysis and processing of the collected data, as we will see further below.

Obviously, apprehending the real work of the teachers by finely analyzing the activities implemented in the classrooms can only be done through a limited number of observed teachers, but our choice has been to explore the practices of high school mathematics teachers, in a more global manner, by trying to express, not for an “authentic” reality of the teaching job, but to approach a certain reality.

As we saw in chapter 2, a teacher’s practices are partly the result of external components which intervene in his/her choices and which we try to apprehend through different analyses. Depending on our different research objects, we were brought to consider such or such component, more particularly allowing a better illustration of our questions. For this research, was paid to the personal component special attention, through the exploration of three variables which were studied more thoroughly: the age, the gender and the professional/academic background of the teachers. In fact, we assumed that these variables can have an influence on the practices of mathematics teachers teaching in high school, and can account for the irregularities or regularities. To carry out this study properly, we conducted several investigations: large scale questionnaires, interviews, session observations.

In the next section, we specify our research problem and the theoretical elements on which we relied to conceive our research, then in the second section, we present the global results of the questionnaire, and in the third section, we focus on the clinical study of five teachers who completed the questionnaire, then we compare the results of these two investigations before concluding on the question of the practices of high school mathematics teachers.

RESEARCH QUESTIONS AND METHODOLOGY

The research studies presented in this book all have a specific entry to deal with the question of regularities and irregularities of mathematics teachers' practices: Roditi (chapter 3) has chosen for example to focus on the maneuver leeway intervenes by four teachers for teaching multiplication of decimals in grade 6, Abboud-Blanchard and Paries (chapter 10) have tried to analyze the influence of the integration of computer tools into the practices of a mathematics teacher.

The research presented in this chapter has the particularity of relying on two studies, one quantitative and the other qualitative. In fact, it seems important to work on a large scale in order to have a global vision of mathematics teachers' practices, and to be able to explore more particularly the personal component which intervenes in their foundation, as well as to work on a reduced scale to refine and specify the study of their practices.

Research problem

We seek to understand the practices of mathematics teachers equally from both a general and a particular point of view, in order to define the "field of possibilities," to describe a certain professional reality which best approaches the "authentic" reality, to give a complete overview of the teaching practices in light of the specificity of the individuals bring them to life.

To properly carry out this research, we will ask simple questions such as:

- Who are the mathematics teachers in high schools in France?
- What are their professional practices in their everyday routine, inside and outside their classrooms? Are there personal variables which are more discriminating than others for the comprehension of the diversity of these practices?
- Can we establish a categorization of teachers which could account for the common practices and the personal shared characteristics?

Theoretical references

Like all the works presented in this book, the theoretical framework used in this research is that of the "double approach," inspired by the activity theory with the differences specified in chapter 2.

The main difference with other works, regarding the quantitative study, is that the teachers' practices are not directly apprehended, this is rather done through fictional teaching situations proposed to the teachers in a questionnaire which includes several questions designed to explore their personal component as well. As for the qualitative study of the practices of the five teachers who completed the questionnaire, the loans are direct and compliant with what was presented in chapter 2.

All the mathematical contents presented in this research are analyzed using tools stemming from mathematics didactics, and more particularly the theory of situations by Brousseau (1997) and the tool-object dialectic of Douady (1986).

To complete these references, we will mention the concept of “ideal-type”¹ borrowed from Weber (1965), which seems quite adapted to describe, the teaching practices as a whole. In fact, this concept allows the construction of a certain reality which can be used as a framework to study the practices of high school mathematics teachers. The sociological references do not go beyond this simple loan.

Methodology

For this research, we have chosen to carry out two studies, one quantitative designed to try to comprehend the practices high school mathematics teachers, in its entirety, and the other qualitative to put to the test this entirety by comparing the results gathered indirectly to the results gathered directly, and to study some points in more detail. In fact, in order to carry out a quantitative study on the teachers’ practices apprehended in a fictional manner, we found it advisable to carry out another investigation, this time qualitative and related to actual reality of the classroom, on a restricted number of teachers who had filled out the questionnaire.

At first, the quantitative study using the questionnaire will be used for a global overview of the high school mathematics teachers and to establish a typology of these teachers and their practice through the personal and professional shared characteristics.

Then, the qualitative study through the observation of sessions will allow us to specify some elements of the real practice of five teachers who are part of the quantitative study and test the typology which was drawn through the study using the questionnaire.

The global methodology of this research study uses tools and concepts presented in chapter 2, which were however adapted to a large scale study for the quantitative study.

The questionnaire

The questionnaire which was the basis for our study should at the same time enlighten us on the personal characteristics of the teachers and give us an idea about their professional practices. Hence, it was conceived in different parts, each with different aims: the first part is to gather as much objective information as possible and about the teacher and the second, to try to apprehend his/her practices “in class” based on fictional situations. The teachers were given quite a heavy questionnaire, including around thirty questions.

The first part had three sub-parts, each designed to gather specific information about the teacher filling out the questionnaire:

- “Who are you?”: personal information about the teacher (age, gender, education, administrative situation, schools worked in, etc.).

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- “Your training?”: to explore his/her career path (training, workshops, etc.).
- “Your practice?”: information about the elements of his/her professional practice, “outside the classroom” (teamwork, organization of lessons, averages, commitment to official instructions, etc.).

The second part of the questionnaire was aimed at confronting the teacher with fictional teaching situations in order to apprehend the elements revealing their practices at specific moments:

- Choice of problem subjects: the teacher had to choose his/her preference out of three subjects that were, almost equivalent in terms of mathematical content, but with different prescribed tasks and formulations. The first (subject 1) is very classical and directive in its formulation and includes questions which allow a simple and guided identification of the function-tangent link, the second (subject 2) is much more concise, leaving the linking of the two notions at stake up to the students, whereas the third (subject 3) imposes the use of a calculator even though it is not really necessary or useful for solving the problem, with questions closer to those of subject 1. The teacher also had to indicate the implementation elements.
- Types of aids recommended in case of difficulties encountered by a student: the teacher had to choose between several types of proposed aids (reference to the lesson, partial information, methodological comments, etc.). We could not at this level differentiate “procedural assistance” and “constructive assistance” (chapter 2) given that the nature of these aids could only be determined *a posteriori*.
- Reaction to an “incident”: the teacher had to react to an unsuitable use of a skill used by a student (using the limit of the rate of change to determine the slope of the tangent to a curve at a given point).

We are aware that this indirect reasoning can create gaps with reality, but it was important to collect as many answers as possible in this study.

All the collected information was processed statistically, using a data processing software (SPAD). First, we carried out descriptive statistics on the two parts of the questionnaire, and then we analyzed these two parts using factorial analyses to create the desired regrouping.

Observations on the sessions

To complete this study using the questionnaire and test our typology, we studied the practices of five teachers who filled out our questionnaire very closely. We chose these teachers since they allowed us to account for the diversity of teachers in our sample, in terms of their personal characteristics. We hence observed and analyzed one “exercise” session of their choice. To analyze these sessions, we studied three dimensions related to the given couple:

- Global study of the scenario;
- Study of the tasks related to the exercises proposed;
- Study of the process and the work conditions of the students.

In this chapter, we do not describe these different elements of analysis explicitly, but we refer to them to compare the two studies.

The teachers' typology

In order to determine a typology of high school mathematics teachers based on personal characteristics and the elements of their practice, we conducted factorial analyses based on their answers to the questionnaire.

THE QUANTITATIVE STUDY

Global overview of high school mathematics teachers

We have gathered 225 questionnaires, mostly sent by teachers from the Académie de Versailles.² Even though our sample is not representative of all high school mathematics teachers, its non-negligible size encouraged us to believe that exploring it would allow us to get a global idea about all high school mathematics teachers in France.

Who are the high school mathematics teachers?

Almost all the high school mathematics teachers had some experience in middle school before teaching in high school (almost 80% of them, 6.6 years on average). Almost half of them had already taught in a “difficult” or “sensitive” school, on average during 7.3 years. Their involvement in professional development is relatively important, since 56% of them said to have attended at least 3 workshops since they started teaching.

If we consider their educational path, we see that there are slightly more teachers who have attended “Classes Préparatoires”³ (56% compared to 44% who went to university exclusively), and they are generally overqualified with regard to the recruitment examination⁴ they sat for.

Furthermore, almost one quarter of high school mathematics teachers are members of the APMEP,⁵ and they have expressed an interest in the history of the subject matter they teach (more than 57%) and in computer science (44%), however only 23% are interested in mathematics didactics. They occasionally read professional magazines (57%), some do regularly (29%), and others never do (14%).

It should be noted that few teachers had another job before becoming teachers (almost 10%).

What are their “outside classroom” practices?

High school mathematics teachers work readily work in teams (47% “regularly,” 46% “occasionally”), in particular to plan their school year progression (71%). In general, they follow the official instructions carefully (only 9% don’t “always” follow them and 21% follow them “scrupulously”) and finish the program in their classes (4% “rarely” finish it and 19% “not always”).

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To prepare their course, teachers use several manuals (71%), or only the class manual (13%), or even have a personal course plan which they adapt to the levels of the pupils in their classes (20%).

The averages are generally increased to the higher half mark (40% of the teachers), or even to the tenth of the mark (30%), very few are increased to the mark above (20%).

What are their “in- classroom” practices?

Students working in small groups is not a very common practice (62% never use it, 33% do so occasionally).

Regarding the choice of exercises which the teachers were given to work on, it seems that the first two subjects, more classical in form even though they were different in terms of the tasks prescribed to the students, were more commonly chosen (51% chose the first one, and 48% the second one). The third exercise, less conventional in form, only got 32% of the votes, but it was often selected as a unique choice (most teachers chose at least two exercise).

As for the choice of the implementation of the subjects, the teachers answered with respect to their interpretation of this question⁶: 46% of them gave us indications about classroom management, 33% made comments about the nature of the exercise, 13% commented them regarding their students.

The question of possible aids did not allow us to determine the function of these aids, whether procedural or constructive. The answers were given in terms of the suggestions that were made. Thus, almost all the teachers (84%) chose the reference to the lesson to help the students with difficulties while solving the proposed problem (this choice was most often accompanied by other propositions). Almost one out of three teachers indicated that he/she would definitely give methodological comments, other specified that they would ask their students to use a calculator (29%), or evoked the possible links with previously solved exercises (35%) or with the different questions of the exercise (42%). Some even suggested providing a partial answer (42%) or intermediate results (15%).

The reactions of the teachers confronted with the proposed fictional incident⁷ were very varied, depending on whether they assumed responsibility for this event or they left it to the students. Hence, they either validated the procedure used by the student while ensuring the necessary readjustment (40%), or they left that readjustment to the students (16%). Some teachers completely rejected the used procedure (6%) or referred the student to the corresponding lesson (15%).

These results provide indications about the way high school mathematics teachers perform certain tasks inherent to their job. They give us a quantitative preview of their practices, while specifying certain elements related to their personal characteristics. They do not claim to convey the professional reality of high school mathematics teachers as it really exists, but rather simply an “approximate” reality.⁸

Results of three specifically studied variables

To explore the answers to our questionnaire more specifically, we chose to look more closely at three variables which we believe are likely to engender differences in high school mathematics teachers' practices: the teachers' gender, their age in terms of three particular age groups (under 36 years, between 36 and 36 years and over 36 years), and their academic background through the examination they sat for (Capes et Agrégation,⁹ externally or internally).

The observations made in the study of these three variables were revealed in the set of teachers' answers and hence must be considered in regard to the limitations due to the relative representativeness of our sample.¹⁰

Gender

- Women seem to show more “professional sociability” while doing their job, through their involvement in group work and professional development. Men seem to work in more personal way. In particular, it should be noted that more women play the role of pedagogical advisors than men.
- Women seem to express more concern regarding certain conformity to their practices to institutional expectations. Men seem to worry less about this issue.
- It is also possible that women are more concerned by the transmission of know-how of mathematics, whereas men focus more on the transmission of knowledge which is more strictly mathematical.
- Women seem to be better mediators than men in the relation of the student to knowledge, mainly regarding the provided aids. Men apparently take the students into account more frequently on the level of the organization of their teaching (“outside classroom” practices), whereas women do it more during the lesson (“in classroom” practices).
- Women can be more open to pedagogical innovations than men, even though this observation does not query the professional dynamism of men. Men on the other hand have expressed more interest in computers, yet we were not able to foresee the impact of this observation on their practices.

Age

The age of the teachers is generally related to their professional experience, most of the observations we have established reflect this reality.

- The “students' parameter” seems hard to account for in the teachers' practices according to their age. It is very prevalent in the practices of middle-aged teachers, but less significant among younger teachers as well as older teachers, for different reasons.¹¹
- The youngest teachers' lack of professional experience seems to be highly related to their practices. This is reflected on several levels: they tend to avoid dispersion and focus on learning the basic professional gestures,¹² and to compensate for this lack of experience, they look for more teamwork, unless they retreat into their shell.

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- The older teachers tend to work in a more personal way, whether in elaborating their progressions or in planning their lesson. This observation is most probably the result of a combination of facts (more professional experience, detachment while exercising their job, generational choice, etc.) which lead these teachers to become more reserved.
- Age seem to also be a determining factor regarding the attitude of the teachers to official instructions. The youngest teachers are more concerned with their practices being in compliance with the institutional expectations, whereas for older teachers this concern seems to be less present and this, even though we noticed furthermore that more teachers among the older ones “always” finish their curricula, while more teachers among the young ones do not “always” do so.
- Most youngest teachers show a significant interest in computers. These teachers however show little interest in didactics, while the older teachers seemed to be more sensitive to that. The latter are also regular readers of professional magazines, while the younger ones rarely read any. Moreover, the APMEP members are usually older teachers.

Academic background

- The practices of teachers qualified through internal examination differ depending on whether their specific path led them to open out retreat into their shell for diverse reasons. Moreover, it must be noted that teachers qualified through internal examination have a wider professional experience in “difficult” or “sensitive” schools, and many of them did not receive any initial training.
- Regarding the different paths followed by the teachers, it seems that teachers who passed an Agrégation internally followed a more similar educational path (or even identical) to that of teachers who passed an Agrégation externally than qualified teachers.
- There do not seem to be major differences in the way teachers elaborate the annual progression of their teaching in terms of the examination they passed. To plan their course, it seems that qualified teachers focus more on one manual whereas this practice is quite uncommon among teachers who passed an teachers’ Agrégation.
- Teachers who passed an Agrégation externally may tend more to position themselves as privileged arbitrators of knowledge in their practices.
- Teachers who passed an Agrégation externally are different in several aspects.¹³ It seems that the preparation of their examination led them to be positioned differently from a professional point of view. We also noted that teachers who passed an Agrégation internally create more methodological aids character for their students.

Typology of high school mathematics teachers

Through our questioning about the practices of teachers studied on a large scale on one hand, and through the common personal characteristics and the shared

elements of practices on the other hand, we tried to establish a typology of the teachers. We hence created partitions (in 3, 4 and 5 classes), based on the answers to the questionnaire, by projecting elements related to the practices on elements related to the personal characteristics. By examining closely the work in the partitions, we finally were able to draw a typology composed of four types of non-equivalent up importance¹⁴, defined by individual and professional criteria.

Here are some characteristic elements of these different types:

Type 1: Teachers who are quite resistant to official injunctions, who do not always follow the official instructions, who are hostile to pedagogical innovations, who organize their course in a personal way, who believe that their practices do not differ according to the classes which they teach, who have not or barely taught in middle school, and who have started their job after passing external Agrégation.

Teachers of this type resist institutional constraints and social adaptations, they definitely believe that their level of mathematical knowledge allows them to teach legitimately.

Type 2: Teachers whose practices can be described as ordinary, since the modalities retained to characterize them show “unexceptional” practices.

What we mean by “unexceptional” is the fact of occasionally reading magazines, generally finishing the curriculum, producing term mark averages that they push up to highest decimal, not being trainers and not being interested in didactics. However, in this group we distinguish teachers who teach in “normal” schools and those who teach in schools labeled “difficult.”

- “Normal” schools: annual progression elaborated rather in a personal way, occasional teamwork with mathematics colleagues.
- “Difficult” or “sensitive” schools: annual progression elaborated in collaboration, regular teamwork with mathematics colleagues.

The differentiation of the schools is reflected on the level of the social exposure of the teachers teaching in “difficult” or “sensitive” schools. The pressure they are subjected to incites them to social adaptation which is not really necessary in “normal” schools.

Type 3: Rather young teachers, who benefited from an initial training in a IUFM¹⁵, they are not trainers, never read magazines, and have not had any professional development training. They do not show particular interest in the history of mathematics, or didactics, some of them are interested in computers. These teachers, in general, did not choose subject 3. Their lack of experience (related to their young age) forced them to avoid dispersion and focus on teaching practices, which allow them to fulfill their duties “properly.”

Type 4: Teachers with some professional experience who have benefited from training in a CPR¹⁶ (hence are not found among the youngest), who have take part in many professional development trainings, who read professional magazines regularly, who are interested in didactics and the history of mathematics. In this

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category, we find pedagogical advisors and a large number of teachers who passed the internal Agrégation. When these teachers have to choose and exercise for their students, they adapt their choice according to the possible management or the content (based on their answers to question a) and do not hesitate to choose non classical subjects (such as subject 3). In order to help their students, they recommend both referring to the lesson and other pedagogical tools (mainly links).

One should remember that this typology aims at providing an “abstractive synthesis of several concrete phenomena” (Weber, 1965, p. 179) and does not account for the “authentic” reality of mathematics teachers and their practices.

QUANTITATIVE STUDY OF FIVE TEACHERS

We then chose to examine more closely the practices of five teachers who filled out our questionnaire and accepted our offer to observe their sessions and interview them. These teachers were chosen because, considering their personal characteristics, they allow us to account for the diversity of the teachers in our sample as best as possible.

The qualitative study

Hence we chose for our study:

- a woman over 46, qualified externally: Mrs. CE1.
- a woman over 46, having passed an Agrégation internally: Mrs. AI1.
- a woman aged between 36 and 46, having passed an Agrégation externally: Mrs. AE2.
- a man aged between 36 and 46, qualified externally: Mr. CE2.
- a man younger under 36, qualified through external examination: Mr. CE3.

The main objective of our visits to their classes was examining more directly the practices of the teachers chosen among those who filled in the questionnaire. The visits also aimed at evaluating the contingent gaps between the answers to the questionnaire and the practices, which are observed directly, and thus evaluate the reliability of our large scale study.

By comparing the results found during the visits and those of the questionnaires of the teachers, we noticed that they were quite similar, and that they did not show any major contradictions. This observation is satisfactory, given that it implies that the questionnaire data is somehow reliable, and can be used to support a quantitative research on the practices.

Some variables are more visible than others when we compare these two surveys. Hence, the weight of professional experience is a datum that we easily identified during our visits. Many of the different aids selected by the teachers in their questionnaires also coincide with those we were able to observe during our visits. We were also able to detect in the practices of the visited teachers traces, which correspond to complaints expressed by the teachers about their students. The choice of subjects also matched what the teachers had offered to their students during our visit.

However, we were not able to master some variables in one session. These are mainly the variables related to the teamwork of the teachers, the group work, or the elaboration of progressions, which is not surprising since these variables account for practices, which are difficult to perceive in one single visit. Similarly, it was impossible to find traces of the academic level of the teachers (degrees) or the path they followed, except for the two teachers who passed aggregations. In fact, the practices of these teachers reflect rigorousness or even a rigidity, which can stem from their previous experience.

Comparison of the two studies

We will now compare the results of the two studies to test their pertinence, even though we are aware that the study of few cases cannot validate them.

Gender

The three women in our study all showed a rather high professional sociability, each in their own way. Mrs. CE1 works equally well in teams, both with mathematics teachers and with teachers of other subjects in her high school. Mrs. A11 regularly works in a team with her colleagues and acts as pedagogical advisor. Mrs. AE2, although she believes she only works “occasionally” in a team, is in charge of the “Kangaroo 19” club of her school. As for the two men of our study, Mr. CE2 said he seldom worked in a team (which goes against the type 2 reference “difficult teaching”), whereas Mr. CE3 does it more willingly (which might be related to the fact that he feels the need to do so as a “young” teacher).

Regarding the fact that women seem to be better mediators than men in the relation of the student to knowledge and mainly on the level of the aids, we can simply indicate that Mrs. AE2 and Mr. CE2 were the only ones who only used procedural aids during their sessions, while the three other teachers provided with their students constructive aids as well.

Age

The practices of the “youngest” teacher in our study do not seem to correspond with the characteristics of his age group, since he does not seem to be constrained by his lack of experience (rich proposed problem and dynamic classroom management) nor is he detached from the contingencies related to his students (varied nature of oral exchanges and aids provided during the session). This difference can be explained by the fact that, at the very beginning of his career, Mr. CE3 benefited from a particular coaching, thanks to a team project in a “difficult” school.

Mrs. AE2 and Mr. CE2 only used procedural aids during their session. They were also the only ones to manage their session exclusively with collective or individual (to a lesser extent) exchanges. This observation could be related to the particular consideration of the “students” parameter by the teachers of this age group.

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The two teachers of the oldest age group revealed undeniable professional experience during their session, on the level of the global organization of their session, as well as the nature of the proposed tasks, or the level of the process.

Academic background

The two teachers who passed an aggregation (one internally and the other externally) have a similar academic backgrounds, which reinforces our observation on similarities in the paths followed by teachers in these two categories.

The professional positioning of the only teacher who passed an Agrégation externally also corresponds to the one we indicated. The nature of the exchanges (mainly collective) and the organization of the session (short research phases, strictly procedural aids) allow us to assume that Mrs. AE2 considers herself to be a privileged arbitrator of knowledge in her practice.

We can also report that the only pedagogical advisor in this qualitative study is the teacher who passed an Agrégation internally, which corresponds to what we had noticed in our quantitative investigation.

The teachers' typology

It was possible to link the association of each teacher to one of the four types of our typology thanks to the information collected during our visits.

We had indicated that many of the teachers belonging to type 1 had passed an Agrégation externally, while many of the teachers belonging to type 4 had passed an Agrégation internally, or were pedagogical advisors, which coincides with the types of Mrs. AE2 and Mrs. A11; yet, we do not attribute a type to a teacher *a priori*, only because of the examination he/she passed. Several parameters must be taken into account in order to be able to class a teacher in one of the four determined types.

Furthermore, a teacher can belong to one type at a given moment of his/her career and then to another type at another moment. Type 3 is mainly a transitional type which can evolve into any of the other three types; this is the cases of Mr. CE3 who is associated to types 3 and 4, since some of his while the others tend more towards type 4. Different teaching conditions and personal elements can lead a teacher to move from one type to another.

Three of the studied teachers were classed in type 4 based on their answers to the questionnaire. The sessions that we observed allow us to enrich and illustrate the reality of this type.

Thus, it appears that these three teachers communicated with their students by varying the nature of their exchanges (collective, individual, semi-collective) and by using both procedural and collective aids, which was not the case of the two other teachers associated with other types. These characteristics can be emblematic of this type, even though they are only linked to elements of practice and not to personal characteristics of the teachers.

Mr. CE2 was classed in type 2, since his practices did not reflect the specificities in the other types. Nevertheless, the differentiation that we made the level of practices linked to the nature of the school ("ordinary" or "difficult") does not

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seem to be relevant for this teacher. It is possible that Mr. CE2 situates the adaptations he must make due to his teaching in a “sensitive” school on another level (than the one we were able to observe).

Mrs. AE2’s session illustrates the practices linked to type 1 of our categorization in an instructive manner, even though she only gives only one visible example. Hence, the fact of proposing complex tasks to the students, while systematically dividing them into sub-tasks during the class and of only providing procedural aids could reveal a practice associated with this type. Similarly, the singular choice of subject (Von Koch flake) worked through a problem personally prepared (which is a characteristic of this type) by the teacher allows us to consider the relationship to teaching of mathematics teachers of this type.

CONCLUSION

The two studies that we have carried out allowed us to get to know high school mathematics teachers better, to describe a certain professional reality and approach some elements of their practices. In accordance with the adopted approach, the quantitative study provided global information about high school mathematics teachers and allowed us to catch a glimpse of a “field of possibilities” on their “outside classroom” practices (teamwork, following official instructions, finishing curricula, using manuals, etc.) as well as their “in-classroom” practices (choice of subject, reaction to a mistake, aids) even though the latter were only approached in a fictional manner. The qualitative study allowed us to examine these practices more closely, to stress some of them, and shed light on a less virtual reality.

The particular study of the three retained variables (age, gender, degrees) allowed us to perceive some variations in the practices of high school mathematics teachers. Professional experience, inescapably related to the age of the teachers, is a discriminating factor, which acts either as a vector of autonomy, allowing more opening out or reserve for the older teachers, or as an inhibiting yoke for the younger teachers, who are thus constrained by a certain pragmatic caution in their profession.

The gender is also a factor to be considered in order to account for the differences at the level of the teachers’ practices (different positioning with regards to the institution, mediations of learning or colleagues), even though we regret that we were not able to perceive in what way it could have any influence, on the level of the relationship with the students.

The examination passed by the teachers allowed us to apprehend some differences, both on the level of the followed track (external or internal) and the level of the type of examination (Capes or Agrégation), but this variable, related to the individual background of the teachers, is difficult to perceive and to analyze. We should nevertheless remain very careful as far as the results of the study of these variables are concerned, that they only reflect a global vision considering, and do not lock the teachers in a very reducing characterization.

The question of the categorization of mathematics teachers based on personal characteristics and modalities of practices has been solved through the choice of

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the four types defined based on our quantitative study and highlighted in our qualitative study.

The choice of these four types, in the conditions that we have specified (frontier porosity, global coherence, etc.), is a tool for me, allowing a global vision of all the high school mathematics teachers' practices. This tool should not be an excuse to lock the teachers in a sterile categorization, which would not take diversity of personalities forming the mathematics teachers' body into consideration and the professional freedom to which they are entitled.

NOTES

- ¹ For Weber, the conduct of social science depends upon the construction of hypothetical concepts *in the abstract*. The "ideal type" is therefore a subjective element in social theory and research; one of many subjective elements which necessarily distinguish sociology from natural science.
- ² This corresponds to approximately 10% of the teachers working in the Academie of Versailles. With Académie of Paris and Académie of Creteil, Versailles is one of the three academies of Region Ile de France.
- ³ First and second year after Baccalaureat for good students devoted to prepare access to ingenious' high school
- ⁴ Among the 37% of certified teachers and 58% of teachers in our sample aggregated over 63% of teachers have at least a master's degree.
- ⁵ Association of Mathematics Teachers from french public schools
- ⁶ The question was: "Can you clarify your choice with the conditions of implementation?"
- ⁷ The teachers must react to the use, by a pupil fictitious, of a method not suitable to solve a simple task.
- ⁸ These are only declarative data and there could be a gap with reality.
- ⁹ In France, there are two types of examinations to become a teacher: the CAPES and the Aggregation (of high level). Students can pass them externally, while pursuing university studies, or internally while they are already teaching without the official title.
- ¹⁰ The statistical representativeness of our sample is actually not guaranteed, for several reasons (age, distribution, gender, professional corps, and so on).
- ¹¹ We assume that the youngest teachers would essentially be preoccupied by mastering basic professional gestures, and that they would have to "leave aside" the "students" parameter then, after getting past this state, they would focus more on this parameter (feeling of guilt or requirement) to be detached from it later on through a professional rebalancing, the fruit of more confident experience
- ¹² Being able to organize the progressions, manage the classroom, evaluate the students, etc.
- ¹³ Less group work than other teachers, an implementation more focused on management, using, etc.
- ¹⁴ For information only, ours ample is divided in the following way: type1 = 20%, type2 = 24% and 20%, type3 = 16% and type4 = 20%.
- ¹⁵ IUFM: Institut Universitaire de Formation des Maîtres that is University department for teacher training.
- ¹⁶ Centre Pédagogique de Formation is Pedagogical Training Center (training center prior to the IUFM).

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