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► To cite this version:

Lynn Farah. The organization of study in French business school preparatory classes. CERME 10, Feb 2017, Dublin, Ireland. hal-01941365

HAL Id: hal-01941365

<https://hal.science/hal-01941365>

Submitted on 30 Nov 2018

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The organization of study in French business school preparatory classes

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This paper presents parts of a doctoral research pertaining to the study of mathematics in French business school preparatory classes. In what follows, we identify the main features of the institutional devices designed and implemented by two mathematics teachers in their respective classrooms in order to influence and transform the working habits of their students. To do so, we rely on qualitative analysis of data collected mainly through interviews and questionnaires. Our conceptual framework borrows constructs from the Anthropological Theory of Didactics as well as several works in the sociology of education field.

Keywords: Mathematics learning, preparatory classes (CPGE), organization of study, teaching devices, teachers' practices.

Context

Student failure in mathematics during the first university years is a widespread problem in many countries including France, but it does not seem to affect in the same way students of all French higher education institutions. In fact, there are in France alternative institutions such as the *Classes Préparatoires aux Grandes Écoles* (CPGE in what follows) students achieve much better results in mathematics than those enrolled in regular French universities, as is reported in official statistics provided by the ministry of national and higher education and research¹. The CPGE prepare students over two academic years after obtaining the French baccalaureate to enter the *Grandes Écoles*, which are mainly business schools or engineering schools, by passing the *concours*, national competitive written and oral exams specific to each type of school which students take by the end of the second preparatory year. In the French educational systems, the two preparatory years at the CPGE are equivalent to the first two years of undergraduate study at university and do not lead to obtaining a degree. The CPGE have three streams, scientific (S), business and economics (EC) and literary (L), which each have different tracks.

Our study focuses on the CPGE in the continuation of the work of Castela (2011). These institutions differ widely from regular French universities in elements commonly considered as the main causes of student failure (Farah, 2015b, chap.II, section 4). They are known for their selectivity in recruiting students who have obtained exceedingly above-average results throughout high school and in the French baccalaureate, as well as their supportive culture, which fosters student collaboration and provides them with close follow-up, in a relatively rigid high-school-like system within stable moderate-sized classrooms. In fact, these institutions resemble more the European and North American universities than the French universities in terms of teaching methods and student-teacher relationships. Therefore, it is important to point out that although our study is conducted in a

¹ Source: <http://www.enseignementsup-recherche.gouv.fr/cid75181/reussite-et-echec-en-premier-cycle.html>

specific environment, its results help us to understand more general issues that concern other institutions in France and in other countries.

With the change of institution, from high school to CPGE, students face a significant rift with respect to the work they have to complete in order to succeed in mathematics. In fact, in the CPGE, students are expected to develop without teacher supervision and in addition to the tasks that are prescribed to them, significant autonomous personal work in mathematics that is not necessarily in the continuity of what ensured their prior success in high school. Moreover, assessment in the CPGE is entirely conditioned by the nature of the examinations of the *concours*. In mathematics, it is cumulative, covering the content of both preparatory years, which is never the case neither at university nor even in high school. In this paper, we are interested in the ways these institutions shore up their students and help them develop a new working mode in mathematics, geared towards the CPGE requirements, during the first year of scientific track business school preparatory classes (ECS). Therefore, we focus on the relationships that exist between institutional and students' personal organization of study in mathematics.

Conceptual framework

We are mainly interested in the institutional dimension and its impact on students' learning in mathematics. We claim that through their ways of functioning, the CPGE institutions help their subjects (the students) construct a new working mode in mathematics adapted to the CPGE requirements. We refer to the foundations of the Anthropological Theory of Didactics (ATD) to examine the weight and action of these institutions (Chevallard, 2003). We endorse Chevallard's (2003) description of an institution as a social system that allows and imposes on its subjects, that is people who occupy different positions within the institution, ways of doing and thinking. Subjects are hence submitted to collective constraints and expectations that regulate their actions and thus subjugate them (in French, *assujettir*). For our study, we consider first, at a global level, the CPGE institution within which individuals occupy the positions of student, teacher, and administrative staff... At a local level, we focus first on the teaching of mathematics in the broader sub-institutions, the EC stream then the ECS track. Next, we consider the teaching of mathematics in the school institution. Lastly, we examine the institution of the mathematics classroom of each teacher, with two main positions: teacher and student.

Regardless of the level of institution in question, it is important to bring forward the idea of organizational stability emphasized by Darmon (2013) and Rauscher (2010). Darmon identifies institutional devices that are shared among CPGEs, which put students to work while supervising them. In accordance with the ATD hypotheses, Rauscher advances that subjects of the CPGE institutions occupying the teacher position (per discipline, hence in mathematics in particular) predominantly share common experiences and background traits. They thus form a distinctive social group, as a result of several interacting mechanisms, and take decisions as a team, or a tribe (*tribu*) as Chevallard (2003, p.89) would refer to it. The hypothesized continuity and stability within the CPGE, as to the norms of the teacher profession and the study organization created by each teacher, enables us to foresee the influence of the global CPGE institution on the students' work.

The work of Darmon (2013) in sociology allows us to clarify certain important aspects of the functioning and role of the CPGE institution, through which it exerts its subjugation actions and the

resourcing of students' personal work. Darmon defines a specific type of institution based on the socializing functions of the CPGE and examines it as an institution where a specific type of person is manufactured. According to her, these “*enveloping institutions*” (p.10) shape and transform the students through preparatory institutional socialization processes. Therefore, she analyzes the different daily functioning devices that make it possible for the institution to exert its effects on the students (“*surveillance, sanction, examination and pressuring techniques*” p.16). It appears that this subjugation process is undertaken by taking into consideration the individuals involved; this is far from common in higher education practices in France and sounds highly paradoxical. In fact, Darmon puts forward the fact that the CPGE strives to soften the preparatory violence. She describes the institution as being powerful but not totalitarian, violent but concerned about the well-being of its members, it operates by individualizing to the extreme rather than homogenizing, thus reinforcing its take over the individuals which are its members (2013, p.28). Her findings converge with those of Daverne and Dutercq (2013) who put forth the regretted yet accepted pressure to which CPGE students are subjected as well as the personalized adaptation of teaching.

Furthermore, we sought to develop the institutional dimension of our research from the point of view of the teachers. We hence considered two levels: the first one pertains to the way teachers are subjected to the CPGE institution; the second one is related to the mathematics classroom of each teacher, the local institution s/he creates thanks to stable devices which we seek to identify. We believe that the subjugations to the CPGE generate an environment in which each teacher enjoys a given autonomy and can freely express his/her individuality within the boundaries of the common CPGE teacher culture highlighted by Rauscher. Using Darmon's work, we bring forward the CPGE institutional functioning analysis in order to explore how the socializing function is exerted.

Therefore, based on the different didactical and sociological elements of our conceptual framework, we address the following research question in this paper: which institutional devices lead to the transformation of the students' personal work mode in mathematics, at both levels of an institution, ranging from the global CPGE institution to the local teacher classroom institution?

Methodology

A first phase of our study, which is beyond the scope of this paper, was entirely centered on students' personal work in mathematics. Using questionnaires and interviews of first year students from two ECS track preparatory schools in Paris (see Farah, 2015a), we gathered data about the organization of mathematics courses, the teaching methods, the assessment tools and the resources provided by the teachers to put students at work and accompany them in the study of mathematics. Based on this, we sought to approach the practices of the teachers by examining the teaching devices they design and implement in their classrooms as well as their meta discourse (Robert and Robinet, 1993, p.1). We must clarify that the word “discourse” refers to verbal expression, i.e. the use of words to exchange thoughts and ideas. It is not a theoretical construct borrowed from a conceptual framework. As for the word “meta”, we refer to Robert & Robinet's definition (1993) whereby a teacher's discourse contains meta elements, i.e. about mathematics and about the ways of doing and learning mathematics. The second phase of our research followed from this.

To answer the research question addressed in this paper, we relied on qualitative analysis of data collected from two mathematics teachers of the schools involved in our study. We started with data

obtained through semi-structured interviews conducted with each of the two teachers about the devices instituted in their classrooms. Then, we designed and had each teacher complete two questionnaires. The first one, inspired from Rauscher's thesis (2010), is about their career path and their choices with respect to teaching in the CPGE, which we believe determine their position and impact their subjugation within the CPGE institution. The second one, inspired from Darmon's book (2013), is about the assessment and pressuring devices the teachers implement in their respective classrooms to put the students to work, as well as their ways of softening preparatory violence in terms of the support and comfort they bring to the students.

We used Qualitative Content Analysis of the interview transcriptions and questionnaire answers to put together a description of institutional devices implemented by each teacher (local) and those common across the different institutional levels (global). The narratives were analyzed thoroughly, manually, line by line, in a search for keywords and vocabulary terms constituting the teachers' discourse about the ways students should study mathematics, while focusing on anything pertaining to institutionalization, regularity, and insistence on specific actions by the students or the teachers. Our search was structured around the following themes that determined the analysis rubrics of our content analysis: taking notes in class, managing work and revisions overall, studying between two mathematics sessions, using resources, preparing for an exam, the *colles*², collaboration between students, student difficulties. We then resorted to triangulation to confirm the information obtained from the teacher-designed instruments by comparing it with what we had gathered in the first phase of our study through the students. We must clarify that, besides the things that converge with the information gathered from the students, we had very few elements that would allow us to determine the propinquity between the teachers' statements and what actually takes place in their classrooms. In fact, one could be surprised that, in an analysis of teaching practices, there have been few filed observations. This limit is due to practical constraints in terms the duration of a doctoral thesis. The final output of our analysis is presented in the form of a description of the different institutional devices that organize and shape students' personal work in mathematics.

Main findings

The findings show that the teachers seek to put their students to work and mold their study methods in mathematics through numerous collective devices instituted in their classrooms. In addition, they closely follow-up on each student's work in mathematics through customized individual devices. Thanks to the latter, the teachers develop and apply diverse pressuring techniques in order to ensure the students' intellectual training and their successful passing of the *concours*. We provide below a description of the main devices, which are either dictated by the global organization of mathematics study in the CPGE institution and thus revealing how the teachers are subjugated to their institution, or specific to one of the more local sub-institutions (for more details, see Farah, in press).

² A *colle* is an assessment tool specific to preparatory classes. In mathematics, it classically takes the form of a one-hour bi-monthly oral examination, in groups of three students working individually but simultaneously, answering lesson questions and/or solving problems on the board, managed by a *colleur* who is present to supervise and grade the work.

The teacher's course and the follow-up beyond

The mathematics course organization and progression are the first aspects of guidance to students' work. For both teachers, when they explain a mathematics lesson, their first priority is to retain the students' attention while encouraging them to actively participate by regularly asking questions. The lesson is completed and illustrated through examples and exercises, which are solved in class or at home, then corrected in class. During regular classroom sessions, if needed, teachers wrap up the work that they have previously started during practical solving sessions (called *Travaux Dirigés* or TD). These special sessions give students room to work on exercises in small groups, thus fostering discussions with the teacher as well as classmates.

Both professors involved in our study use a handout as the baseline for the lesson explanation; they distribute it to students either systematically or occasionally. Depending on the teacher, the class or the chapter, this handout can be exhaustive or having blanks to complete, and teachers modify it regularly in order to tailor its contents to the level of the students and their capabilities (concentration, understanding, note taking ability) and the course pace is slowed down or increased accordingly. The main objective behind the use of such a device is to save note-taking time in class and ensure that students don't make mistakes in copying key elements. A typical handout contains mathematical definitions and notations, propositions and theorems with occasional short proofs, lesson examples and application exercises. During the lesson, the teachers spend most of the time completing the missing proofs then provide additional examples. They explain to students that the proofs are the basis of mathematics, and repeatedly underline the practical and generic aspects to be extracted. On the contrary, little importance is given to statements of theorems. This is an example of a specificity of mathematics teaching in this CPGE stream as opposed to the insistence on academic knowledge in universities. In addition, the teachers formulate several remarks that are not solely about theoretical mathematical knowledge. In fact, in addition to the mathematical content, the teachers make comments related to practical knowledge. These are part of their meta discourse which contains technological elements (Castela, 2011) used to bring forward the know-hows linked to the mathematical content, thus allowing them to accompany students in their study.

In addition to the time dedicated to lesson explanation, exercises solving and correction, both teachers ensure to always be available to assist the students in the learning of mathematics outside the classroom. They are willing to answer questions, provide explanations, recommend and even correct additional work despite believing that the workload they assign is already enough (regular exercise sheets and occasional extra exercise sheets with their correction for some chapters). They usually encourage students not to look for more resources (textbooks, online) and focus on what they provide due to time constraints. Moreover, the teachers hold weekly tutoring sessions to ensure that students are getting all the needed help within the institution. Through their extended availability and individualized follow-up, the teachers are ensuring that all their students are provided with the necessary assistance for their learning, while they control and organize their study. They are thus softening the preparatory violence through surveillance and examination. This is one important manifestation of the CPGE teacher culture that is absent in French universities.

The recurring discourse about the ways of studying

The teachers encourage their students to regularly study their mathematics lessons and solve the assigned exercises (for both the regular sessions and the TD) and they always explain to them how they should proceed to do so. The teachers emphasize the importance of reading a mathematics lesson actively and critically. The objective is learning the keys lesson elements while thinking about them and asking the right questions to first understand then memorize. According to both teachers, validation of the learning should be done by playing-back important lesson contents mentally, then preferably in writing.

In addition, they both stress the crucial role of decontextualizing in mathematics learning. To do so, they underline the significance of both the results brought through proof and the use of generic components of reasoning, in addition to the techniques used in standard exercises which students must be able to acquire and plough back in other situations. In fact, they preach strategic exercise solving whereby students are expected to identify standard problems and recognize methods, techniques and tricks that can be used to solve them, which can also be applied to other problem situations. Thus, according to both teachers, students should have a transfer-oriented approach to exercises rather than one that favors only practice or reproduction (Castela, 2011), the latter are dominant among successful university students but are deemed ineffective in the CPGE. The teachers also insist on the necessity of doubling efforts until mastery is attained when facing difficulties in solving an exercise.

We can refer to the notion of constructive help proposed by the teachers to guide students in studying the lesson, solving exercises and decontextualizing proof and exercises, when working on a daily basis between two mathematics sessions, as well as when preparing for an exam. In fact, we have identified several features of help common to both teachers in their discourse, about expected ways of studying mathematics and practical knowledge pertaining to the techniques which could help students gain know-hows relating to the awaited tasks. These illustrate the convergence of learning methods regularly repeated by two different teachers of the same stream and track.

The assessment tools

In order to ensure that the students are completing the assigned work (lesson and exercises) and to identify their weaknesses and difficulties in mathematics before the graded exams, teachers use personalized informal evaluation techniques during classroom sessions (both regular and TD). They often resort to oral interrogations about the lesson notions by randomly calling on students or choosing those who are inattentive or fall behind. Also, while the students are solving exercises in class, the teachers go around to check what they have done, they assess their understanding and help when needed. Then, the teachers encourage the students to engage in discussions about the exercises' solutions before correcting them or asking a student to do so. One of the two teachers gives special care to exercises preparation by the students prior to class. In order to push students to maintain regular work, he periodically calls students to the board and collects notebooks without prior warning whenever he notices that the work has not been fully done, without necessary grading any. These are all examples of surveillance and sanction techniques that allow the institution to monitor and redirect the work of the students' work.

The teachers have several types of more formal assessment devices, institutionalized at the global CPGE level, which allow them to evaluate the degree of investment and understanding of their students. Firstly, they use all sorts of written evaluations. Teachers mainly resort to short quizzes focused on the mathematics lesson content (definitions, theorems...) at the beginning of the school years to push the students to study, however they state that they cannot maintain them throughout the year due to time constraints. They also have monthly exams (called *Devoirs Surveillés* or DS), and bi or triannual mock *concours* which are summative and are conducted in conditions similar to the official *concours*. One of the teachers quizzes his students about the correction of previous DS exams thus allowing the students to detect and address their weaknesses. In addition, teachers assign and grade homework sets (called *Devoirs Maison* or DM) on a monthly basis and they usually invite students to work on those in small groups. All of the above are examination and pressuring techniques used across the CPGE institution, with specificities of each sub-institution.

Last but not least, the *colles* are the most important assessment tool that teachers use to evaluate their students in a highly customized manner. We summarize the main perks they list about this institutional device, which are for most specific to the case of mathematics *colles* in the ECS track, since their organization and functioning changes across disciplines, tracks and streams. The *colles* impose on the students a work and study regularity, which is certainly stressful and tiring for some, but the pressure is eventually seen as beneficial for the majority. Mathematic *colles* sessions are described as similar to private tutoring sessions where students can discover their weaknesses, ask questions, obtain additional explanations and a new point of view, and practice by solving additional exercises. Further to these mathematical learning related aspects, the *colles* are characterized by their interpersonal feature and the know-hows and social skills they teach (stress management, oral presentation, self confidence) which go beyond the scope of the classroom or even the school. Therefore, the *colles* are viewed as a summary of the best things the CPGE have to offer in terms of learning environment for their students (Daverne and Dutercq, 2013, p.182). They are to many teachers the secret to students' success in CPGE (ibidem, p. 182), despite the difficulties and constraints they are subjected to.

Discussion and conclusions

On one hand, we can conclude that the teachers who took part in our study are heavily involved in their students' learning. To accommodate the needs and level of a "*new population*" (ibidem, p.7) of CPGE students, more diversified in terms of academic and social backgrounds, teachers redefine their teaching modalities and pedagogical devices and adjust the level of their expectations. Daverne and Dutercq state that if some young students have good working habits when they enroll in the CPGE, none yet have the general culture nor the confidence needed to face the *concours*, which requires from teachers a high level of commitment towards them and a constant care for their moral (ibidem, p.8). Hence, the teachers participate in the didactical and pedagogical organization of their students' autonomous study thanks to the advice they provide and the devices they institute and regularly adapt according to their needs and capabilities. They are therefore clearly dedicated to their students' success. This is also reflected through the closeness in the student/ teacher relationships, which we do not tackle in this paper (for more information, see Farah, 2015b).

On the other hand, although the use of the varied pressuring techniques in mathematics differs among teachers and depending on the students' dispositions, the techniques themselves remain redundant across teachers and classes. This brings forward their generality and continuity within the EC stream of the CPGE institution, of which they become a specificity. As a matter of fact, we find in the teachers' discourse common features underlining the coherence in the practices of teacher tribes per class as well as the stability of practices within each preparatory school, within the ECS track, and even within the entire EC stream. Regardless of the level of the institution, the devices used are specific to the teaching and learning of mathematics, even though we do not examine them with respect to a specific mathematical content in this paper. We conclude that the coherence of practices noted between the two teachers involved in our study concurs with what the sociological studies of Rauscher (2010), Darmon (2013), and Daverne and Dutercq (2013) have identified.

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