

TEACHERS MANAGING THE CURRICULUM IN THE CONTEXT OF THE MATHEMATICS' SUBJECT GROUP

Cláudia Canha Nunes

Fernando Pessoa School, Lisbon

João Pedro da Ponte

Institute of Education, University of Lisbon

This study addresses the teacher daily practice. The goal is to understand, from the teachers' perspective, the challenges and difficulties that they face when attempting to involve the pupils in mathematics learning. We are particularly interested in the issues that arise when teachers assume curriculum management decisions in the context of the school mathematics department. The methodology is qualitative and interpretive, with case studies. The results indicate that curriculum management supported by the collaborative context creates tensions when a teacher makes decisions that diverge from those assumed collectively and also between the collaborative group with an innovative approach to teaching and teacher professional identity.

Key-words: Curriculum management, mathematics, mathematics subject group.

A key element of teachers' professional practice is the way he/she interprets and manages the curriculum, taking into account the students' characteristics and the conditions and resources of the school. This study draws on several fields of knowledge: teachers' professional knowledge and identity, curriculum management in mathematics, and collaboration and leadership in school context. It strives to understand the practice of collaborative curriculum management in the context of a school mathematics department. Particularly, we address two questions: (i) How teachers conduct curriculum management, in this context, as they attempt to diversify students' learning experiences? (ii) What is the potential of collaborative work around curriculum management in the development of a professional culture at the school?

CURRICULUM MANAGEMENT AND TEACHERS IDENTITY

It is usual to distinguish different curriculum levels – e.g., the prescribed (or formal) curriculum of official documents, the available curriculum mediated by school textbooks, the curriculum planned (or shaped) by the teacher, the curriculum in action enacted by the teacher in the classroom, the curriculum learned by the students, and the curriculum evaluated, for example, through national examinations (Gimeno, 1989; Stein, Remillard & Smith, 2007). Curriculum management refers to the actions of the teacher that contribute to the construction of the curriculum in the classroom (Gimeno, 1989; Ponte, 2005). For the teacher, the focus of the curriculum management process is students' learning, and it is according to this (at least in theory) that he/she takes all the necessary decisions. Therefore, as Ponte (2005) suggests, curriculum management has to do, essentially, with the way the teacher interprets and shapes

the curriculum, on two levels: a *macro* level, concerning the overall planning of teaching for an extended period, and a *micro* level, corresponding to the teaching process in the classroom. The teacher makes decisions selecting tasks, strategies, and materials appropriate to the objectives and purposes of mathematics teaching, taking into account his/her students and working conditions. The teacher adjusts the curriculum as he/she evaluates and periodically reflects on his/her professional practices. Nowadays, as a curriculum manager, the teacher faces new challenges: the modern society poses constantly new demands on schools, the student population assumes a cultural diversity never seen before, and curriculum orientations proposes a major change on the role of the teacher, from a “deliverer” of knowledge, to that of a facilitator of learning.

To teach well, the teacher must know teaching techniques, the content of what is taught, the students, and the school context (Shulman, 1986). But, fundamentally, the teacher teaches what he/she is (Elbaz, 1983; Ponte & Chapman, 2008). The teacher’s professional identity is an aspect of his/her social identity, which presupposes the existence of a community providing ways to think and act which constitute collective values (Dubar, 2002). Ponte and Chapman (2008) indicate that in the construction of a professional identity, the teacher takes the culture, values and norms of the professional group, but also has the possibility of influencing and thus contributing to the transformation of the group, mobilizing his/her cultural background and personal experience. Moreover, the socialization process of the teacher at the school and in his/her mathematics department is often complex, sometimes inhibiting the experimentation of new ideas, the involvement in curriculum innovation projects and the establishment of personal relationships and sharing of experiences. This process makes a real the duality that often exists between the model of professional culture devised by the teacher and the reality that the teacher faces in daily practice (Ponte & Oliveira, 2002). In order to schools experience a significant development, the most important element to address is the teachers’ professional involvement and collective work (Nunes & Ponte, 2010). These critical dimensions may help understand how

teachers develop their work, including how they manage the mathematics curriculum.

METHODOLOGY

This study follows a qualitative approach (Erickson, 1986), with a case study design (Stake, 1994; Yin, 1989). The study involves a group of 14 mathematics teachers of a secondary school with 12-18 years old students. The mathematics teachers have an extensive experience of working collaboratively and, in recent years, they developed various projects at the school. Most of these projects emerged from the need that they felt to improve their practice and to help students to overcome their difficulties. During the school year 2007/08 the teachers of the mathematics department developed the project “Investigations, proof and problem solving tasks in textbooks and in curriculum management”, involving all classes from grades 7 to 12. This project aims to diversify tasks in the mathematics classroom, in order to encourage the students’ in learning mathematics.

This study considers the group of teachers involved in the project and within that group, focuses particularly on three teachers: Ana, the coordinator of the mathematics department, Matilde, a teacher that arrived recently to school and to the department, and Simon a teacher at the school for 28 years. These cases provide several contrasts that enable understanding the relationships between professional knowledge and curriculum management, as well as regarding collaboration and leadership at the school. In this article, we present a small glimpse of the cases of the three teachers.

Collection of data was done during the school year 2007/08 and includes participant observation (Jorgensen, 1989) of the teachers' working sessions and of two classes, with record of field notes in a research journal, two interviews with each of the three teachers selected for case studies, and collection of documents (Adler & Adler, 1994; Patton, 2002; Yin, 1989). According to the research plan, data analysis began simultaneously with data collection, to identify the need for further collection of data. The second level of data analysis involves the development of categories focused on professional knowledge, curriculum management, collaboration, and leadership that may help in noticing interesting relations. The third level of analysis seeks to explain the meaning of the data, in order to provide contributions to the understanding of the phenomenon under study (Merriam, 1988).

RESULTS

The group working sessions

This group of teachers holds a session every week, for three hours, working collaboratively in curriculum management. Usually, they start altogether collectively but to work in a specific school level they splits in subgroups. Collectively,

The group shares their practices experiences, plan and prepares tasks and assessment instruments, defines classroom strategies and questions to help students in their difficulties, and later the group reflects on students work, in particular in the tasks related to the group project that are realised in all grades [Research journal on Group Working Sessions-GWS].

In subgroups of two or three teachers,

They plan teaching units, using first the textbook and other curriculum materials, particularly the official curriculum documents; construct assessment tests; and discuss specific issues related to the school level involved [Research journal on GWS].

Also the purpose of these subgroups is,

To plan lessons and regular practice, defining common tasks to be developed and classroom strategies with different classes, sharing experiences and difficulties teachers with colleagues [Research journal on 10th grade subgroup work].

During the working sessions all teachers are invited to participate and have the opportunity to share and express their point of view. All work is developed in a supportive

environment and there are friendly interpersonal relationships among all teachers. This dynamic is focused on a particular concern of this group of teachers – developing and practicing an effective mathematics teaching that may guarantee students’ success in their learning: “We want them prepared for the future, especially those who want to access to higher education” [Ana Interview-INT, 25/10/2007].

Some of these teachers, being aware of the educational changes, strive to be always updating their professional knowledge [Researchers’ journal, GWS]. This may explain their frequent participation in professional meetings outside the school. Also, this may clarify why these teachers are invited to share what they learn from those meetings by providing of a workshop based on what they learned for the other colleagues of the group. As an example, a teacher has attended an in-service training course in calculators and he organized a workshop for his colleagues on this topic [Research journal, GWS 2].

There are different statuses and roles assigned to each group member. Since the last ten years, one norm of this group is that there is always a teacher responsible to lead the group of teachers that are teaching classes from grades 7 to 9. One of the teachers, Simon, explains:

This leader is chosen from the group of teachers that belong to this school for more than 15 years. He/she has to teach grades 7 to 9 and has to be replaced every three years. When none of us is there [leading] things go wrong! There are problems with parents, some of the curriculum topics are not achieved... [Simon INT, 16/10/2007].

Simon’s words suggest that the group seeks to take into account the expectations of students and parents. This may explain why the teachers manage the curriculum and build the assessment tools in group or subgroups. Doing so, they strive to harmonize them with the views of all teachers and to support the decisions of each teacher about their own students’ learning and assessment.

Also, this seems to be a way the group found to support the younger teachers, who are usually responsible for teaching middle school grades, as this allows a stronger regulation of the teaching-learning process to assure the quality of students learning in these grades. In contrast, older teachers are responsible for teaching grades 10 to 12, but every three years they have to teach one or two classes from grades 7 to 9, keeping in close contact with all the issues of all school grade curriculum goals and eventual changes.

The professional experience of the three teachers

Matilde has 11 years of experience teaching mathematics classes from grades 7 to 12. She is in this school since 2006. She has already worked in seven different schools performing roles as a mathematics teacher and as a class director. She has a degree in mathematics teaching. She says that, outside the school, all her time is dedicated to her family.

Ana is 39 years old. She has been a teacher for 12 years and she has a master's degree in mathematics. Her capacities and work are recognised by all mathematics teachers by the school community. The results get by her students in the national exam are well known and the number of her students who go into university contribute to this social recognition. At the beginning of the school year of 2007/08, she was elected, by her colleagues, the head of the mathematics department. Her colleagues mention that "Ana's first reaction was panic because she felt that she was not prepared to face the challenges and she did not know all the tasks involved in this job" [Research journal, 11/09/2007].

Simon is a teacher with 28 years of experience teaching mathematics classes from grades 7 to 12. Throughout his career he played several roles in his school such as deputy head teacher, in-service teacher education coordinator, department coordinator, and project coordinator (of mathematics projects and of other school projects). He is an in-service teacher educator in professional development courses and belongs to several working groups in and outside his school. Because of his professional experience and the initiatives he promotes in the group, Simon is recognized by his colleagues as the unquestionable leader of the group. This academic year he has only grade 12 classes.

Matilde, Ana and Simon are in different stages of their careers and have a relationship with the school and the mathematics group marked by their personal and professional trajectories.

Managing the curriculum: Individual dimension

Concerning the individual work of the teachers in managing the curriculum, Matilde shows little identification with the perspective of the group. The voices some concern in the decisions that she makes in the classroom when using more open tasks; Ana shows confidence in taking decisions in relation to the work to develop with students; and Simon shows how to articulate the work with the textbook with working on open tasks, diversifying the tasks proposed to students.

Matilde teaches grades 7 and 8. The way she works with open tasks in the classroom, contradicts the view of the group in relation to mathematics' teaching and learning:

Matilde – I think that I often influence the students' reasoning while they are solving a problem. I say what they should do! (...) I do this because I have to go on!

Simon – That exactly what you should never do!

Sebastian – We have to control our selves! We have to go step by step, questioning the students but wait for their answer. They have to think by themselves. Today you spend some time more, but you will gain tomorrow because your student have learned and achieved the goal. We can help you! [GWS, 20/11/2007].

In this discussion it is possible to understand that Matildes' decision contradicts the perspectives of the group about the way of manage student work with open tasks. It is also perceptive that Sebastian, the leader of the subgroup grade 7 and 8, tries to give Matilde some clues to help her future working, sustained in his large teaching experience (26 years).

Ana teaches grade 12. She follows the planning done in the subgroup and, in the classroom, she uses the textbook as a central resource. She offers to the students the tasks that are prepared in the context of the grade 12 Subgroup:

I do something that I already did a few years ago, it is not new. I issue students a challenge and I want them to write anything about these issues. They write funny mathematics' reports. [Ana INT, 26/09/2007]

Simon teaches grade 12. He follows the planning done in the subgroup and, in the classroom, he also uses the textbook as a central resource. He also offers his students the same tasks as Ana but he proposes solving them in two phases. He argues that classroom work must be focused on the student. The first approach is always the textbook. [GWS, 11/09/2007].

To learn, students have to like what they are doing, and so what I like most is that they solve their own problems. First, I would like them to be able to read a problem and not turn their arms down, not get discouraged, therefore grasping the problem. (...) Achieving that with my classes is to get weapons to grasp and solve the problems which arise. [Simon INT, 16/10/2007]

In summary, the evidence shows us that Matilde has some difficulties to manage students' difficulties while they solve more open tasks and decides to provide them the answers. Simon tries to help his students to be autonomous assuming that students have to reflect on their own work and mistakes to learn.

The three teachers and the mathematics subject group

In this section we present some of the dimensions of the relationship between the teachers and the group. Matilde does not identify herself with the culture of the group, Ana shows some embarrassment related to her role as head teacher, and Simon appreciates the dynamics and the work that the group develops. As the natural leader of the group, he nurtures his relationship with his colleagues using curriculum management as a focal activity.

Matilde recognizes that she is an outsider regarding the group:

I feel [quite outdated] by people who are here in school for longer than me. (...) I never felt this, but [now] I feel, because I think they [the other teachers] search for professional development training and I do not. [Matilde INT, 15/01/2008]

But at the end of the study, Matilde recognises that she has learned a lot with the teachers of this group:

In this group I felt that we should invest: I saw happy teachers even when difficulties emerge. We fell supported by my colleagues and still have a lot to learn to empower my practice [Matilde Final Reflection - FR, 14/07/2008].

As a mathematics teacher, Ana needs to share her work with her colleagues. As subject leader, she considers this to be a “special” group, where all the work is planned in collaboration and where there is a strong reflexive attitude, all members sharing with each other their own practices and experiences:

This is a special group. We work together for a long time. I hope it will stay like this! This one is the first [school] where the teachers of the mathematics department work in collaboration sharing all the tasks. [Ana INT, 25/10/2007]

I've been a coordinator, in a school much smaller than this one at the beginning of my career. (...) Working with colleagues is sometimes difficult. I have a bit of fear in this task, but I try to be ready. [Ana INT, 08/05/2008]

Ana refers to Simon as the catalyst element of the working processes developed inside the mathematics' subject group, and, in the different projects developed by the group. She refers to him,

He has his own beliefs about how professional and school culture should be – with strong collaborative work and a continuous development and learning attitude – and the entire group follows his vision [Research journal].

Furthermore, and besides the fact of being the subject leader, Ana decided to share the coordination of the school project. She looks at collaboration as a natural working situation of the members of the subject group and as a tool for help, support, and sharing:

I am always telling what happens in my classes and I like to know my colleagues' experiences, so I can have different opinions on my decisions and classroom strategies [Ana INT, 08/05/2008].

Decisions about assessment provide an interesting episode concerning the relationship of Simon and the group. In fact, the other grade 12 teachers felt that the students should do assessment tasks just in one phase. That is what Ana and Diogo indicate:

Ana – I think that if the task is to assess the students' learning then it has to be done individually. (...) I do not agree to give a second chance, because there are students with private tutoring and already know the task and many of them can provide ready-made answers.

Simon – I think that they perform much better in a second stage. And I do not agree with you [Ana] that the reason is that they have external help and they already know the task.

Diogo – I agree with Ana. In addition, if it counts for assessment, we have to do all in the same way, so that some [students] benefit and others do not. [GWS, 20/11/2007]

However, Simon decided to use a different strategy and gave a second chance to his students to improve their first response to the task, once corrected and commented. This decision was discussed in the following working session, as Simon announced his decision and suggested the group to analyse and reflect on the performance of his students in both phases. There were some negative reactions, especially from Ana and Diogo who have disagreed with Simons' decision [GWS, 4/12/2007]. The issue was taken up later at meetings in which the group built tasks and discussed how to implement them in the classroom [GWS, 15/01/2008; 19/02/2008; 8/04/2008; 6/05/2008]. As a result, some other members of the group began to use Simons' strategy. In particular, at the end of the study Diogo admitted that this strategy can help students improve their learning, as he has verified with his own classes [GWS and FR, 14/07/2008].

Simon says that the discussions that the group has done in the project working sessions have been very “interesting” for him. In particular, he stresses the construction of open tasks and the definition of criteria to assess and to reflect on the results of students:

The construction of tasks with a group of proofs, problems and explorations and investigations and their implementation in the classroom, the discussions we had in the sessions, has always been very enriching, and the exchange of ideas and clarification of points were a highlight of this project. (...) Discussions on the grading of the students' work on their achievements and to give them feedback were undoubtedly very important aspects for my learning. The contributions of all colleagues made me to reflect on my practice in these aspects, questioning what we did and discovering ideas and suggestions perfectly workable in practice in the future. [Simon FR, 14/07/2008]

CONCLUSION

Ana, Matilde and Simon are teachers in different phases of their careers, from the same mathematics department that work collaboratively. The results of this study show that the curriculum management made in the context of a collaborative group and the various initiatives of the group in developing innovative practices that involve the development of exploratory tasks are significant changes in educational practice and enable the sustainability of a culture of collaboration (Nunes & Ponte, 2010). There are situations that generate conflicts in the group, especially when most participants favour some decision and some individual practices diverge from that, as illustrated by the case of Matilde and Simon.

But this dynamic and working context seem to motivate the involvement of the teachers in teaching and learning. In particular, such dynamic appears to support the professional development the teachers and their capacity to accept new challenges.

For example, Ana feels that she still has much to learn. But the context, in which she develops her profession, in particular the subject group she leads, represents an advantage for her. As one of the youngest members of the group, when she was elected subject leader, she chose to have a quiet and learning attitude. Every time she needs help she asks her colleagues and she can count on them for collaboration and experience, mostly from Simon.

One important conclusion that we draw from this analysis is that Simon, the natural leader of the group, bases most of his relationship with his colleagues in the activity of curriculum management. The professional practice of these teachers, supported by this working environment, shows that current curriculum orientations may be implemented not just at an individual or small group level, but by a whole school mathematics department.

Finally, the group culture and collaborative work seems to help in the gradual socialization process of new elements such as Matilde, while fostering a climate of confidence conducive to sharing experiences and difficulties (as showed in the discussion involving Matilde, Simon and Sebastian in the group working sessions), essential elements for the construction of teachers' professional identity and professional development (Ponte & Chapman, 2008).

From this study new issues emerge for future research, namely: How teacher's practices and curriculum management influence students' learning of mathematics? What conditions are necessary in schools, and more widely in the social context, so that this kind of collective curriculum management takes place, very much in line with current curriculum orientations?

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