A COLLABORATIVE PROJECT AS A LEARNING OPPORTUNITY FOR MATHEMATICS TEACHERS

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This paper analyses the evolution of Maria, a mathematics teacher involved in a long term collaborative project together with a researcher and two other teachers. The study aimed to understand teaching practices and to develop richer classroom communication processes. It follows a qualitative-interpretative approach, with data gathered through recording of meetings and interviews. We discuss to what extent this project became relevant for the professional practice of Maria. The results indicate the potential of collaboration to understand communication phenomena in the classroom, putting practices under scrutiny and developing richer communication interaction patterns between teacher and students.

Key-words: Mathematics communication; collaboration; professional development.

INTRODUCTION

The possibilities of collaboration between teachers and researchers as a research strategy are receiving increasing attention. Collaboration is an opportunity to combine joint work with individual input, taking advantage of the potential of different individuals building a common experience (Hargreaves, 1994). In this paper, we take collaboration as an experience shared by a set of people who identify a common interest and establish and implement a working agreement, providing mutual support and challenging each other. This perspective defined a collaborative project involving a researcher (the first author of this paper) and three mathematics middle school teachers, whose purpose was to understand classroom communication, putting practices under scrutiny and developing richer communication processes.

Our research question enquires what are the influences, if any, of a collaborative project on the conceptions and practices of a teacher regarding classroom communication. It links concerns emerging in recent research on collaborative work, (Boavida & Ponte, 2002; Jaworski; 1986) and classroom communication (Alro & Skovsmose, 2004; Lampert & Cobb, 2003; Sherin, 2002). Here we restrict the scope of analysis to Maria, one of the teachers. In particular, we discuss to what extent the project became relevant to her professional practice. First, we discuss the meaning of collaboration in educational research and how communication was understood within the project group. Then, we present the methodology and analyse the "case" of Maria.

Finally, we end with a discussion concerning issues that arise in collaboration as a research strategy in mathematics education.

BACKGROUND

Collaboration. Collaboration plays an increasing role in educational research. In a collaborative project, participants may take advantage of working together (Kapuscinski, 1997), but often tensions emerge along such a process. They arise, for example, from the different attitudes teachers and researchers maintain towards practice, planning, motivations or use of knowledge (Kapuscinski, 1997; Olson, 1997). There are, of course, a variety of collaborative structures, and corresponding different degrees of individual commitment – as indicated, for example, by Clift and Say (1988), Day (1999), Goulet and Aubichon (1997), and Wagner (1997). A number of aspects, however, are recognised as consensual as characteristic of any true collaboration. One of them is that the relationships between the participants should not be hierarchical. Mutual support requires some sort of egalitarian base (Boavida & Ponte, 2002). There are, of course, different roles, a difference which, moreover, should be made clear in the group, but all roles must have similar relevance. Another element concerns diversity, understood as an added value to collaboration, which should be assumed as such by the group (John-Steiner, Weber & Minnis, 1998).

In a collaborative context, participants do not waste time to promote what they believe to be their own image (Fullan & Hargreaves, 1991). Disagreements are frequent and welcome, given that discussions are centred in values, purposes and practices. A considerable effort is required to build a collaborative culture, which always supposes an effective personal development. In particular, it requires making explicit some common objectives inside the group. Each participant must be aware of her/his own role in the way he/she relates to the others and cares about such a relationship (Drake & Basaraba, 1997). Teachers' involvement in a project depends on how they perceive its relevance, namely to practice, as well as on the way decisions are made inside the group (Bonals, 1996). Essential to the success of a collaborative project is also the ability to carry on reflection exercises together (Day, 1999). To develop such an ability to think critically with others requires some degree of maturation in dealing with doubt and incertitude (Fernandes & Vieira, 2006).

The benefits of collaboration are well documented in the literature. Fullan and Hargreaves (1991) and Maeers and Robison (1997), for example, mention how it helps teachers to feel less isolated and impotent. It is also a factor for change in educational practices, namely when the collaborative experience is made public (Olson, 1997). Active involvement in a collaboration and sharing of concerns and experiences promotes personal and professional development (Lafleur & MacFadden, 2001) as it leads to increased self-knowledge. Collaboration increases the self confidence of every participant (Maeers & Robison, 1997).

Collaborating along a reasonable period of time is not an easy task. Collaborations are fragile, by definition, requiring balances that often are difficult to set up and maintain (Fullan & Hargreaves, 1991; Olson, 1997). Therefore, planning and flexibility, dialog and negotiation, are essential to any collaborative project. Finally, managing expectations, emotions, personal differences, becomes fundamental whenever a collaboration is to be maintained.

Communication in the mathematics classroom. Several authors underline the importance of communication processes in the mathematics classroom (Bishop & Goffree, 1986; Ponte & Santos, 1998; Yackel & Cobb, 1998). Communication is a social process along which participants interact, sharing information and mutually constraining their activity and evolution. It concerns not only an heterogeneous set of interactive processes evolving in a classroom but also their contexts, underlying denotations and expressive resources. Such a perspective includes two issues clearly identified in the literature (Ponte, Boavida, Graça & Abrantes, 1997) in the study of communication in the mathematics classroom: (i) *continuous interaction* between the actors in a classroom, and (ii) *negotiation of meanings* understood as the processes such actors set to share their own ways of making sense of mathematical concepts and procedures, and their evolution and relation to the formal curriculum contents.

Mathematical learning requires a stepwise construction of a reference framework through which students construct their own personal account of mathematics in a dynamic tension between old and newly acquired knowledge. This is achieved along the countless interaction processes taking place in the classroom. Of especial import are the interactions between students and teacher, which simultaneously constrain and are constrained by the kind of lesson. For example, in a learning context in which the teacher stresses exposition and solving exercises, he/she tends to control the whole process. In other contexts he/she may assume instead the role of a coordinator. The nature of the questions posed by the teacher is particularly relevant, leading to the development of communication and reasoning skills (Barrody, 1993).

It is widely recognised the fundamental role that the teacher plays either in enabling or limiting the communicative processes within the classroom (Barrody, 1993; Lappan & Schram, 1989; Pimm, 1987). Such a role makes itself explicit from the outset, for example, when selecting challenging tasks or encouraging students to express and argue their own views (Lampert & Cobb, 2003; Ponte & Santos, 1998), or else when resorting to tasks and educational materials that put the focus of the lessons on mathematical ideas, conjectures or intuitions, instead of calculations and procedures. The teacher is also responsible for creating an atmosphere of self-esteem and mutual respect, so that students feel comfortable to participate, as well as for structuring the classroom discourse.

METHODOLOGY

This paper reports a study, qualitative and interpretative, based on a case-study design (Yin, 1989). This is part of a broader research project involving three case studies developed within the context of a long term collaborative project on communication in the mathematics classroom (Martinho, 2007). The project involved a researcher, the first author of this paper, and three mathematics teachers, Maria being one of them. This group was initiated by the first author who invited a teacher with whom she had already collaborated, who later invited two other teachers to join. Along a year and a half, the project involved regular meetings devoted to a variety of tasks, namely, analysis of documents, lesson planning and review, free debates on communication issues, and project planning and evaluation. Each teacher selected a number of lessons to be observed and recorded by the researcher, and finally these lessons were discussed in group meetings. Data gathering for this research study was based on two semi-structured interviews and on the recordings of group meetings and the researcher's field notes. The aim of the interviews was to get a deep understanding of the way the teacher reasoned about her own communication practices. The focus was on creating a friendly environment to allow a natural flow of conversation about the topics of interest. The recordings of group meetings and the researcher's field notes provided complementary data about the teacher activity, concerns and reflections at each moment. Data collection and analysis were carried simultaneously during collaborative work, mutually influencing each other. The research adopted the interactive model of analysis (Huberman & Miles, 1994).

The project started in 2004, with regular working meetings taking place every fortnight (in a total of 25 meetings), along the whole academic year of 2004/05. From September 2005 onwards, meeting periodicity changed to a weekly basis. Even today, after the formal closing of the original project, the group still meets every week, including now two more teachers. All of them, except the researcher, work in the same middle school.

RESULTS AND DISCUSSION

Maria. Maria is 52 years old and counts 31 years as a teacher. She is married and has two children, already grown up. She assumes her work with professionalism and commitment. For 6 years she served as a school principal and is quite active in a trade union. She has an accurate sense of public service and citizenship. In general, Maria is resolute, determined, and always exigent with herself. She concluded a bachelor degree in chemical engineering in 1974. Becoming a teacher was not her first professional option; only later, she completed another degree on teaching biology and geology. At present, she teaches mathematics and natural sciences. This background may explain her main concern as a mathematics teacher: to provide evidence of the usefulness of this subject.

Maria feels some difficulties in several mathematical topics (she often says that she is not a mathematician) and this clearly influences her teaching practice. She has a deep respect for mathematics as a wonderful world that, however, she is not able to master easily. Mathematics, in her view, is a network of abstractions, concepts and methods, tightly connected. Therefore, she fears that her way of teaching, emphasizing a detached view of each concept or sub-area, may not contribute to make mathematics an interesting and motivating subject for her students. Therefore, she seeks possible links among the topics she teaches, but recognizes her difficulties in improving her practice just by herself. In the group meetings she eagerly took notes of any observation seeming profitable regarding mathematical connections. To some extent, this feeling of inability in giving a unified view of mathematics was challenged (and altered) during the collaborative work.

Maria within the collaborative project. From the outset, Maria played an active role in the project, assuming the group as a personal learning experience. Among the topics addressed she mentions the joint discussion of lessons and their previous planning. In such a context, she said, "it becomes easier to try new experiences" (M15, January 05)[1]. Moreover, in several occasions she values the importance of group discussions: "The interest of this sort of work, even if not to learn a lot of new things, is to put us thinking and to raise new questions" (M23, June 05).

We describe several influences of the project on Maria's communication conceptions and practices. First, she acknowledges how fundamental it is to recognise one's own communication failures so that effective change becomes possible. She values the group discussion of past lessons as a step in building such awareness: "I guess what matters to identify communication problems in the classroom is to be able to identify failures. Often, the daily routine is so pressing that we are unable even to recognise them" (M25, July 05). She also points out that it is too easy to blame students when a lesson fails, instead of recognising communication problems. For Maria, the role of discussions in small groups became increasingly clear: "Only when we meet in a small group, like this, and begin to ask what's going wrong, one becomes aware of difficulties in communicating with our students" (M25, July 05).

Second, Maria also emphasizes that our joint work helped in breaking the daily routine of isolated teachers which tends to obfuscate the real problems. Among these problems she underlines how difficult it is to respect students in their heterogeneity:

> We talk to the average student, forgetting those with extra difficulties or kids with different ways of making progress. We still plan lessons in a sort of canonical format that is the format we have rationalised from our previous experience as students ourselves. In the absence of sharing experiences and mutual questioning, we still go on the same way. (M25, July 05)

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[1] (M15, January 05) stands for the transcript of the 15th group meeting, hold on January 2005.

Third, Maria focused in some particular elements of her practice. For example, she was challenged to address the issue of students working in groups in mathematics classes. She had already some experience of group work in natural sciences classes, but wondered how this could be done in mathematics. Along the project she tried a number of experiences with group work, allowing students to work by themselves and discussing results afterwards. The project was most helpful in modifying her initial conviction that this requires much more time than conventional lectures to cover about the same contents. She used to say:

> Sure, these steps [group work] help students to build deeper mathematical insight. My doubt is: and time? (…) How much time can one devote to discovery, building insight, mastering mathematical reasoning? My dilemma is: build mathematics or follow [successfully] the national curriculum. (M18, March 05)

Later she comments on an experience carried out on a statistics unit: "It took five lessons; normally I need less than that for this topic" (M22, May 05). But she acknowledges the fact that this activity was a training experience for herself. Training for developing more careful lesson plans and a few routines enabling her to "waste less time", or, as she notes, "to use the available time with increased quality" (M24, July 05).

Finally, we observed her effort to take into account in her own practice the main concerns shared in the project group. For example, she indicates that she does a serious effort to reduce the number of interventions she has in the classroom: "A number of things inside my own mind are already working. For example, reminding me: let's see what they think, what they say" (M22, May 05). She became more attentive to what her students say. Similarly, she sought her students to listen more carefully to each other. She points out episodes illustrating her greater willingness to give more time for students answering and reasoning in class: "before [the project]", she commented, "I used to guide their answers, suggesting a possible way of handling the question straight away" (M21, May 05). Note that she recognized that such an attitude "was made possible because of the discussions within the group" (M21, May 05). Moreover, she said "my concerning with negotiation of meaning increased as a consequence of our work. Now I require students to give proper and detailed explanations and raise themselves new questions" (M22, May 05).

The project was lived by Maria as an opportunity to think about the impact of communication issues in the classroom and their relevance as a source of common difficulties in teaching. This is further illustrated by her comment in the last meeting of the academic year 2004/05: "A fundamental issue is to be aware that several daily difficulties in our professional life are related to communication" (M25, July 05). And, later, she wrote concerning the work developed:

> (…) Discussing together what classroom communication effectively means, studying a few theoretical papers as well as experience reports, our own availability to share our classes with others, to reflect in a critical way about our own practices, all this made the

project sessions a true opportunity of professional development. Several connections were built at different levels (pedagogical, scientific, didactical), giving to this group a real sense of what needs to be changed and how. (June 06)

An indicator of the relevance this collaborative project had for the three teachers involved was the decision they took to extend it behind the initial closing data: The group still goes on at the moment of writing. Quite recently Maria wrote in an email concerning group planning for 2008-09: "I am completely available for this project. Actually, it is an irreplaceable space for sharing, knowledge building, and friendship" (September 08).

Maria always supported the project with enthusiasm and a pro-active attitude: sharing plans, discussing suggestions, inviting others to assist to her lectures. She never neglected the possibility to discuss a lesson, sharing her own thoughts and taking care to make explicit the strategies used and her motivations underlying them. The project influenced her practice with respect to the sort of discourse and interactions with students, but mainly, as she stresses, in what concerns her ability to bring variety to her lessons and relationships with students. Maria understood this project as a personal challenge, not always easy to follow. But she was always willing to share: "I have to wait so much, until Friday, to tell you…" And this led another teacher in the group to comment: "This group is our therapy" (May 06).

CONCLUSION

The purpose of this study is to illustrate how a collaborative project can influence its participants and have an impact on their practices. Maria was chosen as the focus of this paper since she was the teacher who was most influenced by the project. Probably that happened because she took such a decision from the outset: To be open to the group influence and look into it in a positive, pro-active way. We shall now extend the discussion to the group level.

The focus of this research was communication in the mathematics class, a broad theme that may include a variety of issues and experiences. As it developed, however, it became clear to the researcher that a collaborative research entails the need for never avoiding or ignoring the questions raised by the participants or the issues that they think are most relevant, even if this implies taking less obvious "routes".

Allowing others to come into their own classroom as well as sharing and discussing their experiences had a deep significance to all the teachers involved in this project. Maria was no exception. But this did not evolve without concern, and the feeling that something that used to be "private" was now made available to others. A number of fragments of a discourse seeking auto-justification provide evidence that collaboration is a process that extends itself in time. As underlined by several authors (e.g., Fullan & Hargreaves, 1991), mutual support in the group is essential to get through, or at least to control, our own difficulties and vulnerabilities. Just as it happened with Maria, the project helped all the others to increase self-confidence,

reducing the feeling of impotence and solitude. This role, which is central in a collaborative project (Maeers & Robison, 1997), was recognised by all the participants, with different degrees.

A collaborative project is a social construction. As such, it entails the need for all participants to share their different ways to approach a situation or experience (John-Steiner, Weber and Minnis, 1998). The relative heterogeneity of participants made mutual influence possible and played an important role in the perception that the group has of its own development.

For the researcher, this was a rich experience, namely as an opportunity to approach very closely school reality and the way it is experienced by teachers. Nothing is given once and for all, and so sometimes she felt tired, unable, almost lost. But progress was made because in the group we have always felt that, in spite of difficulties, we needed to go on because it was exactly from our disagreements that we evolved as a group.

This research study shows that, even with a highly motivated group, changing is always slow. The steps to undertake cannot be too large. Often, the researcher felt that her attempt to propose a number of experiences and activities was fruitless: What is really necessary is that every teacher in a collaborative group takes the group objectives as his/her own.

Along the project, Maria assumed herself the role of researching her own practice and provided evidence of how that entailed changes in her professional practice. This seems to be consistent with related research (e.g., Fernandes & Vieira, 2006) which shows that collaborative work fosters an attitude of serious enquiry about the teacher's own practice. As a consequence, Maria considers herself now more able to challenge her students, to develop their autonomy and to explore their mutual interactions in the classroom. She feels them more active and responsible towards their own learning. She is confident about her stance, but keeps saying that to make changes effective one needs a reflexive attitude and time to mature.

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