

**COLLABORATIVE WORK AND PROFESSIONAL DEVELOPMENT  
OF MATHEMATICS TEACHERS:  
THE ANALYSIS OF A BRAZILIAN EXPERIENCE**

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**Abstract**

This paper describes the creation and consolidation process of a collaborative work group whose aim was to promote the professional development of Mathematics teachers. During one year a group formed by mathematics teachers and researchers met in the city of Campinas, Brazil. The data were collected through audio recording and transcriptions of meetings, evaluations and various records produced by teachers in the study. The results show different phases in the group's life along the year. From the original constitution, when teachers were expecting researchers to lead the meetings and organize the material, gradually the group reached a phase of shared responsibility for the development and preparation of meetings through collective choices. The analysis indicates that the participation in the group contributed effectively to those teachers' professional development and that conditions such as voluntary participation, support, conversation, reflection, affection and the study of specific topics were crucial for the process experienced by the group. However, we observed difficulties in this kind of work. Factors as time, low financial remuneration, lack of support from their peers and school principals hinder the participation and the effectiveness of the proposal very difficult. Although many difficulties were faced by the participants, this research shows that collaborative work plays a potentially large role in the professional development of Mathematics teachers.

**INTRODUCTION**

A number of initiatives and proposals for the reform of Mathematics Education have been presented in the past decades. However, many experiences that were developed have not been successful. In our opinion, the adopted perspective is not the most appropriate. Often, the projects implement courses developed in other places – government, universities – with the belief that they are the best solution for the “problems and difficulties” of the Mathematics teachers. The teacher is not perceived as a partner, as a professional with knowledge and invaluable experience and ideas. We believe that Mathematics teachers need to be listened and invited to choose the areas and the topics that they desire and need to study.

We propose creating a different alternative, one of a researcher and mathematics teacher group where the participation is voluntary and the decisions are made collectively. We understand that as teachers improve their knowledge, more specifically their knowledge about themselves, and experience various possibilities to develop their professional practice, they become more aware and capable of looking for the needed conditions for self-development. The purpose of the study is to create an environment where universities and schools are involved together, sharing their knowledge and practice, in order to generate new knowledge and new practices.

### **CONCEPTUAL FRAMEWORK**

Professional development is understood in this paper as a non-linear process, with a variable duration, that involve the teachers initial and continuing qualification as well as their experience as students and teachers. It is marked by personal, motivational, social, cognitive and affective factors (Ponte, 1998). The personal characteristics of the individuals, their stage in life, their personality and motivation to change, the encouragement or pressure they face in society and their own cognition and beliefs, values, and objectives play an important role in this process. We can say that professional development involves the dialects of the teachers beliefs, types of knowledge and previous experiences against a new type of knowledge that generates more information and affects their teaching practice (Llinares, 2000).

Our proposal was to create an environment that allowed the teachers to acknowledge their own cognition and practices, to evaluate them in terms of their own objectives and expectations regarding Mathematics teaching and learning, and finally, from the new information about its development, to decide on whether or not to re-create them, while giving a new meaning to his knowledge. That was the teachers first step to becoming agents of their own learning process. The core of this inquiry was to build a working practice supported by their school (on elementary and high school levels) and the culture of the university to generate knowledge for those environments, and mainly to contribute the teachers' professional development for the improvement of Mathematics teaching and learning. In that sense, the collaborative group seems the most appropriate context.

We conceive a collaborative group as one in which the participation is voluntary, where all the individuals involved are looking for professional improvement, trust and mutual respect

that give support to their work. The participants work together for a common purpose, creating and sharing meanings about what they are doing, their lives and professional practices. In such a context, the participants feel comfortable to express their ideas freely, eager to listen to criticisms and to change their ideas as there is no absolute truth and the activities do not have to follow an only fixed orientation. Group participants may have different levels of involvement, different interests and viewpoints, contributing then to a great variety of ideas.

## **METHOD**

From a qualitative point of view, we conducted four case studies. At the same time, we analyzed the process of formation and consolidation experienced by the group.

### *Participants*

Besides the researchers (authors of this paper) four other elementary and high school Mathematics teachers working at public schools in the city of Campinas were engaged in this study: Iva, Maria, Fernanda and Andrea.

The youngest of the group, Andrea, graduated from UNICAMP about two years ago and has taught Mathematics and Physics at elementary and high school levels in public and private schools. The isolation she felt in the schools she was working and her willingness to improve her knowledge of mathematical contents pushed her to be part of the group. Fernanda has gotten a degree in Mathematics teaching at UNICAMP and has been teaching for four years in both public and private schools at various levels. She frequently attended courses and workshops, in search of opportunities to learn new methodological strategies and alternatives. Her participation in the group reflected her willingness to share experiences and collectively create new alternatives for the classroom. Iva has been working as a teacher in public schools for more than twenty years. In 2001, she was teaching full time in many different schools. The idea of having a study group and creating activities was not new to her. She had been thinking about such opportunities for a while and had already discussed it with Maria. Maria was also a public school Mathematics teacher with twenty-five years of professional practice in public schools.

### *Data Collection*

The group had thirty meetings between January and December, 2001 that lasted three hours and a half each. The dynamics of the meetings included: a) a study of mathematical contents

previously selected by the group, and b) share experiences and elaborate methodological alternatives for the development of mathematical contents in the classroom supported by the report of the teachers' and researcher's experiences. The data were collected through the: transcription of the meetings, field journal, texts produced by the teachers, and written evaluations.

### *Data analysis*

In this qualitative study, we made use of case study as a methodological strategy for the analysis. This means to have a careful and deliberate examination of a specific question, looking for its most essential features. The case studies involved in this research were developed using two distinct but complementary units of analysis: teacher and group.

In the elaboration of that case study we used both a triangulation of data sources and triangulation of researchers. In this process, we were supported by all the information collected during the year as well as by our own personal notes. Besides, we established a form of dialogue with the literature so as to evidence not only the similarities and differences between our findings and those of other researchers, but also to establish a theoretical reflection about the process.

## **THE COLLABORATIVE GROUP: THE PROCESS AND RESULTS**

Our group was not a collaborative group from the beginning. Collaboration increased gradually. In the beginning, despite the fact that the teachers were encouraged to present their ideas and doubts, they expected us, university teachers, to prepare the materials and organize the meetings. Although our objectives were collectively decided, we established a collaborative relationship. In our case, the fact that the teachers were not responsible for the organization of the meetings somehow limited their participation, although they showed commitment and engagement in all the activities. However, this was natural and expected. The teachers needed some time to get to know each other and develop some level of trusting and understanding about their roles in the project. The belief within the group was that what counts is to be aware of one's own limits and try to

overcome them either by asking for someone's support or by finding support in a text whenever the need to expand knowledge was necessary.

We understand that the way the researchers organized the first meetings was crucial for the participation of the group members along the process. When the teachers felt accepted, respected and valued for their experiences and ideas, they would become more confident in themselves, in the group and more willing to make their ideas heard or to face criticism.

From the beginning, the activities of the group were related to the review of the literature. It was supported by activities that were proposed by the group and guided by the researchers in the analysis of the process of group constitution. Moreover, we perceive that the proper dynamics of the group - their practices and routines, activities and readings - also was influenced by the theory. During the meetings, time was dedicated to the reading and study of texts, as well as discussion related to the proposals and materials.

Something started to shift sometime during the first meeting and gradually became more evident. One specific activity that occurred between the months of March, April, May and June would greatly influence the process of creating a collaborative work group. The activity in question was the investigation of the students' knowledge of fractions.

During the period of our investigation, the authors observed that the group's position consolidated and effectively became a collaborative work group over time. In the beginning it was observed that the teachers seemed to expect some type of guidance, some orientation about what to do. The group had entered another type of relationship, that of collaboration.

By the end of six months, the researchers evaluated the work of the group. We present below the teachers opinion about the meetings:

*"In what concerns the dynamics of our meetings, I can only praise them [...] c) I feel good when I feel I could complete an activity, [...] e) and find that homework is real good [...] it is like a link and I feel motivated for the next meeting [...], f) I love to receive copies of the articles [...] I feel important when I have a text in my hands, which will help me improve my work" (Andrea).*

*"The work is living up to my expectations due to the harmony and synergy that there is among us [...] One great point was the presence of Ana Cristina in the classroom because it allowed me to clarify my doubts and have some self-criticism about by way of being" (Fernanda).*

*"I found that it is necessary to research continuously about Mathematics contents and not simply follow the lessons in a book [...] I feel that everybody is anxious to improve and that it was worth engaging in the group because I have learned a lot from everybody" (Iva).*

*“The meetings have encouraged me to review my classes and find what to do to change my way of teaching. As I am not able to do it immediately, these ideas will remain in my mind, so that during the second semester, I’ll apply these ideas to my classes” (Maria).*

The ongoing work with content and group didactics, the experience with activities and the introduction of innovative activities in the classroom allowed for the expansion of the professional knowledge about mathematical content and the didactics about the students. Those elements were met throughout the year. We could observe that the teachers related to them in a different way, being more or less active and critical depending on the movement. Initially the tasks were performed with interest and curiosity but the teachers were not so critical about their own selection and organization of the tasks. After some time they started analyzing the activities related to the reality of their classroom (students’ characteristics, resources available, etc.). Finally, they were critically analyzing each activity, observing and detecting problems, inconsistencies and potential so as to allow the teachers to implement, at their own rhythm, those that seemed suitable to the needs of their classes.

*“Iva: Then we were able to see, and discuss all this. I liked the class, their involvement... [...] And I realized that they were involved also. They were, you know, all asking and participating. Not a hundred percent, as I told you, no. [...] And students who had never participated before became engaged. And finally they said to me: ‘What a class you taught! I like it this way.’ [...] And they asked for other classes like that” (Iva, 01/09/01, tape 41, p. 8).*

Those were important moments for the research. All members of the group learned from the reports of those who had done the experiment. Our knowledge about the students increased. Besides, sharing opportunities also encouraged the teachers who were more resistant in trying to innovate.

*M: “Then I got there and said: \_‘look, today we are going to work on a different subject [...] you’re going to read everything in detail’. [...] \_‘Hey, what’s a scale’? that I don’t what, they seemed worried, \_‘but what should I do? How does this thing work? How do I measure that’?. [...] I had to move from desk to desk to help them doing the measurement. [...] Even so, they asked too much, too much. [...] So I found it complicated. [...] Nobody said: \_‘oh, that’s cool’! Nobody said so...and I had to reprimand some four pairs of students there [...] it was terrible, then I had to complain [...] Now that’s what followed: I found it kind of positive to have them interested in showing the value here around the contour, measuring, showing that they were learning. So I found it positive” (Maria, 10/11/01, tape 41, p. 11-13).*

The analysis of the activities experienced, their adaptation and implementation in the classroom, connections to the production of class records were extremely valuable for the process of looking back at the group activity and processes through reflection and analysis of our

own practice. Producing the records allowed the teachers not only to review the classes recorded, but also to realize their objectives while reviewing their actions from the results obtained. Moreover, the participants' metacognitive processes were expanded when the group discussed their texts. Besides having their own viewpoint about themselves, they also had that of somebody else for whom they felt affection, trust and respect. All this contributed greatly to a more conscious view of themselves as teachers, of their pedagogical practice, and its possibilities and alternatives.

Nonetheless, the process of learning and changing was not equally fulfilled by all of them. The group members accomplished distinct tasks according to their experience, phase in life, personal and professional background and individual characteristics. While for Andrea the group proved an opportunity for personal support, boosting of self-esteem and self-confidence, for Maria it meant a moment to review her professional history and changes in the educational system and in the behavior of the students. This opened the possibility to modify her beliefs concerning the roles of the contents, teachers and students. In other words, the experience of participating in the group had specific and personal meanings for the teachers. This richness was clearly seen in the case studies (Ferreira, 2003).

## **CONCLUSION**

The success of this group is associated to existence that the some desirable conditions for this type of work: small size of the group, regularity of the meetings, that occurred in dates collectively agreed and previously established, and implicit conditions (such as the accomplishment of tasks). The researchers implemented a collective action plan, that is, the meetings were organized to reach a goal decided by the group. The group constantly encouraged the presentation of individual and collective records and reflection. All group members were given the same status (participants in this project were entitled to share their opinions and to express their ideas freely, while the others listened attentively). The focus of attention was directed to the teaching and learning of Mathematics, and periodical evaluations were applied (Murphy & Lick, 1998). Moreover, in contrast to the research that defends groups formed for teachers only (Antúnez, 1999), in this group, the teacher-researcher partnership, school-university, revealed a constructive aspect that printed a particular dynamics to the works. The

evidences suggest that, depending on the characteristics of the members of the group and their collective intentions, this partnership can bring great benefits for all.

Teachers and researchers worked together, each one coming from their own particular realities, their history and their development as professionals, sharing knowledge and constructing new forms of conceiving and developing education and learning. The group confirmed that those processes demand more time than we initially thought. Involved in a complex context, the culture of the classroom and, more specifically, the pedagogical practice of each teacher does not change so fast. We found that there is an initial moment when you learn for yourself and about yourself. You expand your knowledge on mathematical contents and their didactics, on students and yourself. Through this process, the teachers awareness of their classes, aims and objectives are also expanded. However, it takes time to reflect on their pedagogical practice. And this time depends on individual characteristics: time to adapt to a new way of working, a new view of the interaction between teacher and student, student and teacher, a new view of the curriculum and of Mathematics itself.

## REFERENCES

- Antúnez, Serafí. (1999) El Trabajo en equipo de los profesores y profesoras: factor de calidad, necesidad y problema. El papel de los directivos escolares. *Educar*, 24, p. 89-110.
- Ferreira, Ana Cristina (2003). *Metacognição e desenvolvimento profissional: uma experiência de trabalho colaborativo* (Tese de Doutorado, FE/UNICAMP).
- Kilpatrick, Jeremy et al. (1992) Historia de la investigación en educación matemática. *Educación Matemática e Investigación* (pp. 15-96). Madrid España: Editorial Síntesis.
- Llinares, Salvador. (2000) *Formação de professores y Educación Matemática* (Conferência pronunciada no ato solene de inauguração do curso 2000-2001 na Facultad de Ciencias de la Educación de Melilla, Espanha, 6 de outubro de 2000).
- Murphy, Carlene U. & Lick, Dale W. (1998) *Whole\_Faculty Study Groups: a powerful way to change schools and enhance learning*. California: Corwin Press, Inc..
- Ponte, João P. (1998) Da formação ao desenvolvimento profissional. *Actas do Profmat 98*. Lisboa: Associação dos Professores de Matemática, p. 27-44.