

## GROUP AND INDIVIDUAL DEVELOPMENT IN MATHEMATICS TEACHING: A CASE STUDY

Barbara Georgiadou-Kabouridis

University of Surrey Roehampton

***Abstract:** This paper addresses issues derived from an ongoing research project which attempts to explore the kind of support that inexperienced primary teachers need in their struggle to embed the development of their mathematics teaching within the demanding school programme. Research is conducted in group and individual level. In this study I investigate how teachers' parallel concerns, being members of a group and at the same time individuals, affect one the other. This particular investigation is approached through the case study of one of the teachers participating in the research programme.*

### **Background of the study**

A number of research programmes based on the constructivist paradigm have been developed in mathematics education. In the context of such programmes educators and researchers cooperate with inservice teachers and provide evidence of teachers' development of thinking and classroom practices as a result of their involvement in these programmes. In most cases teachers' participation is managed through seminars and courses offered by the educators, which aim at teachers' professional development. However, examples exist of teachers conducting research and developing their teaching outside an academic framework but sustained by educators. In both cases and most often teachers work in different schools but share a common pursuit of their teaching development.

The above situation is likely to be located on another basis when teachers who participate in a research project belong to a group with many common features. Investigating in a group of teachers requires enquiry in issues related to the nature and the organisation of teamwork. It seems that there are fewer opportunities for developing teamwork with teachers in schools than is usual among professionals in other settings. The main reason is likely the fact that much of the work of teachers is

done alone with the children in the classroom (Everard & Morris, 1996). On the one hand, team building is an important approach to the development of individuals and organisations (Everard, 1995). On the other hand, management principles of effective team building are likely not applicable in case that group participants are teachers in the same school. In this case the group is automatically built and a number of issues related to teachers' involvement in group-work, like their expectations from this work, their interpretations and possible influence of group-work on their own work in their classroom are raised. Teachers being members of the group and at the same time individuals are likely to have two parallel concerns. Why, how and in what extent does the one affect the other, if so? What are the particular factors that reveal and improve interrelationships among teachers' parallel attributes?

In this study I attempt to explore possible answers to the above questions through the case study of a teacher, Gina, who works in a primary school in Greece and participates in my research project together with her colleagues. Gina's attitudes within the group and in her own classroom are examined within the context of dominant local socio-cultural issues.

### **The current research**

This study elaborates data from my doctoral research programme. Since 1987 Greek primary teachers are graduated with four-year studies diploma. Since 1998 they sit examinations if they wish to be appointed in public schools. Inservice teachers have almost no chances of being supported in developing their teaching generally and particularly in mathematics. As a result of this existing traditional practices are recycled.

Within the aims of my research is to explore a way to support novice primary teachers in developing a critical and research oriented attitude in their teaching of mathematics that is hindered by the constraints of their socialisation in the school environment. For this purpose I cooperate with a group of six novice teachers with

common characteristics: young people recently qualified from university departments; no previous classroom experience except the one gained in this particular school; concerned of teaching mathematics "effectively" but they find that their methods unsatisfactory; mathematics teaching based on the pupils text-books and homework with exercises and problems similar to those in the pupils textbooks. (In Greece pupils textbooks are given free by the Ministry of Education, which also communicates the national curriculum to teachers, pupils and parents through the textbooks).

The methodological framework for the research programme is an adaptation of the Teacher Development Experiment (Simon, 2000). In this framework I conduct my research in two levels: within the group of the teachers and with each teacher as individual. The field study is developed in a number of strands. Interpretation of and reflection on gathered data from a strand is fed back into my conceptual framework and organisation of the subsequent strand.

Concerning this study the analysis is based on data collected in the first and second phases by using the following methods: the transcripts of the audiorecorded group meetings; the transcripts of audiorecorded interviews I had with the teacher; the transcripts of videorecorded sessions in her classroom; notes I kept while observing Gina teaching in her classroom; notes from our discussions about her views of mathematics and its teaching.

### **Gina, the teacher**

Gina had completed a four-year programme of studies to become a primary school teacher. Her teaching experience in mathematics was based both on her teaching practice in the university and on the private tuition lessons she offered to primary pupils. Last year, when I started my research project, Gina was in her third year of teaching in a real classroom and at this time she was the teacher of year 3 (8 to 9 years old). In parallel to her involvement in my research project Gina is enrolled in a

distant learning programme concerning the education of children with learning difficulties. Observing Gina while working in her classroom I realised that she had the central role in the whole teaching process. For example, children had to follow certain steps suggested by Gina in solving problems and when they faced difficulties with this Gina intervened and led the child back to the desired path. For this purpose she asked the pupil adequate questions in order to elicit desirable answers. The children's steps were under her continuous control and undesirable answers were ignored.

Gina believed that mathematical knowledge could be obtained through repetition of rigorously constructed processes. For example, she engaged pupils in solving problems that they had already solved in previous sessions *"to make children consolidate the processes of solutions"*.

### **Exemplifying Gina's attitudes and practices**

In the first group meeting the teachers were invited to discuss general problems they face in their mathematics teaching. Gina stressed the gap between university courses on mathematics and mathematics education and prospective teachers' teaching practice. Her remark revealed an important issue in prospective teachers' mathematics education in Greece: the approaches to mathematics and mathematics education courses vary in different university departments and prospective teachers' teaching practice is not always linked to the courses (Potari, 2000). Moreover, Gina believed that educators had ready made solutions to classroom problems but for some reason, possibly related to their theories, they did not provide them to the student-teachers. *"They (mathematics educators) do not provide us the "know how". They (mathematics educators) claim that there are not recipes in didactics of mathematics. But, we get in the classroom and we do not know what to do. I wish I had recipes to apply whenever my pupils do not understand the mathematics I teach them."* Such reliance supports a rather passive and limited view of mathematics and its teaching and learning (Brown, Cooney & Jones, 1990). This reliance could probably be attributed to Gina's fragment

university teaching practice and lack of support in her first steps in teaching according to evidence from the interview and discussions with Gina. Then, when I tried to challenge Gina's reliance by asking her to suggest possible ways that could help in changing her practices, she answered: "*We must share our experiences from our practice and discuss particular issues of the curriculum of mathematics (in the primary school)*"

Gina's sound reflections played an important role in my considerations and planning of the group-meetings. In the subsequent group meetings I encouraged them to present and discuss research papers on mathematics education and relate them to their own experiences. The papers I selected were written in Greek and concerned teaching in Greek classrooms. More specifically, one of the papers referred to the different ways that prospective teachers used educational material in Greek classrooms in the context of their teaching practice (Georgiadou, B., Markopoulos, C. & Potari, D. (1998) "Educational material and teaching practices"). This approach was based on the perspective that mathematics teachers need knowledge on mathematics, pedagogy and children's ways of thinking (Cooney, 1994; Even et al, 1996). In the discussion that followed the presentation Gina argued that time limits do not permit the use of material in her classroom. She also claimed that in the rare teaching sessions where she used material she had to interrupt the process because she considered that "*children couldn't manage to go to an end*". Motivated by the presentation and the discussion the teachers were involved in activities with different manipulatives, such as Dienes Blocks and plastic strips with regularly spaced holes so you can join them together. First they were invited to link this material with particular mathematical notions and secondly to plan imaginary activities, where children using the material could explore and possibly construct these notions. The teachers shared their ideas and discussed the implementation of these ideas in their classrooms.

A paper presented in another meeting studied primary pupils' conceptions of constructing solids (Potari D. & Spiliotopoulou V. (1994) "Pupils' conceptions of

constructing solids"). The teachers were given clixi to explore different nets of different solids and pieces of paper to construct their own solids. Getting involved in mathematical activities teachers could be able to appreciate their children's strategies through their own solutions. This perspective was likely to be influenced by the theoretical position that teachers need to reflect on their own mathematical learning in order to understand better their students' learning, see for example Amit & Hillman (1999). It seems that through her involvement in the group meeting Gina's view about educational material had been challenged. In the interview we had two months later she considered as positive the fact of using materials in her teaching either to introduce mathematical notions or to engage children in enquiring possible answers to their questions. For example, she used Dienes Blocks in her classroom to teach kilograms and grams. In this case she used the 10X10X10 cube as a visual representation of the kilogram, while the 1X1X1 cube represented a gram. Only one set of the material being available forced Gina to demonstrate it while developing a dialogue with children. In another session Gina had set a problem to engage her children in the addition of fractions with the same denominator, while she was working with Phillip, a child with learning difficulties. Gina had given to the children two similar carton chocolates, one of strawberry and one of banana flavour, each divided with lines in 5 equal pieces and asked them: "*I ate 1/5 of the strawberry chocolate and 2/5 of the banana. How much did I eat altogether?*" And then a child asked: "*Suppose one chocolate had 4 and the other 5 pieces?*" That moment Gina decided to continue her work with Phillip and manipulated that child's unexpected question by giving to children again two similar carton chocolates but this time one was divided in 4 and one in 5 pieces.

Gina's involvement in the group engaged her in a metacognitive situation regarding her practices in problem-solving. "*We impose to children the answers that we want. We do not give them time to explore solutions to the problems*" Gina had claimed in the first meeting. Although when Gina reflected on her way of teaching problem-

solving she found it unsatisfactory, however she did not change it. The analysis of a problem-solving teaching session, that was video-recorded the next day of the interview, showed that Gina followed the teaching approach that she had followed three months ago.

## **Discussion**

In the examples presented above Gina referred to a number of obstacles that according to her beliefs inhibited her of being effective in her teaching: lack of adequate teacher preparation programme in her initial education, time pressure in the classroom, lack of children's experience in handling materials.

Gina's reflection and active participation in the group meetings led her to begin the long process of overcoming some of these constraints. In such cases the transition from reflection and change of beliefs to change of practices is rather long (Thompson, 1992; Raymond, 1997). However, it seems that working within a group Gina was provided the motive and the tools to prove to herself and to her colleagues that she is competent and undertakes responsibilities. In her first steps towards change she interpreted her new experiences from the meetings and tried to adapt them within the margins of her working environment. The change concerned practices we had considered in the meetings but they could not be appreciated by people outside the classroom, like parents and the principal of the school. This was possible the reason that Gina did not move from her problem-solving teaching method. This method was suggested to the teachers by the principal, who avowed in his interview that he visited the classrooms to find out whether his suggestions were followed by the teachers. Twice a year the school tested children's problem solving abilities by using the method they had been taught. Children's homework concerning problem-solving was also constructed in the above pattern and there is evidence that parents supported its continued observance. Brown & Borko(1990) recognise the influence of external forces, persons and mechanisms on teachers as members of professional culture.

Adler (2000) asserts that the practice of teaching is constituted by all factors that have been considered as influencing Gina's teaching of problem solving and many others.

Gina believed that she was trapped in the net of this community of practice: principal, parents, problem solving pattern. The dilemma here seemed to be whether the power of this community as it was perceived by the teacher was a "real power" or an "apparent power". How could I support the dynamics of the group to encourage investigation into this dilemma? How could work in the group meetings strengthen Gina's steps towards change? What could my approach be to identify the skills she might develop in order to face the unavoidable problems that such a change could provoke? The ongoing research will explore possible answers to the above questions.

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