

FROM UNIVERSITY TO SCHOOL: A LONGITUDINAL STUDY OF A TEACHER'S PROFESSIONAL DEVELOPMENT IN MATHEMATICS TEACHING

Barbara Georgiadou – Kabouridis

University of Surrey Roehampton

U.K.

Despina Potari

University of Patras

Greece

This paper reports findings from a longitudinal study of a newly qualified elementary school teacher from the last year of her university studies up to the third year of teaching in a primary school. The development of this teacher's teaching has been investigated in three strands, which have been distinguished in terms of the kind of support provided to this teacher. In particular, the teacher's characteristic view of mathematics teaching as a process of children's involvement in activities acquires a different meaning in her teaching actions as she experiences the various contexts.

Introduction

A number of research programmes on initial mathematics teacher education have been developed focusing on the integration of mathematics, pedagogy and children's ways of thinking (Cooney, 1994; Even et al, 1996). Most of these programmes are characterized by a constructivist view of learning, emphasising the role of research in the mathematics teacher's development (Simon, 1995a, 1995b, Steffe and D' Ambrosio, 1995) and viewing the teacher as researcher and reflective practitioner (Rice, 1991; Joffili & Watts, 1995; Potari, 1997). Although research studies indicate positive results from these programmes, questions remain on whether and how the experience that these prospective teachers gained through their initial education could influence their professional life. There is also a body of research that investigates mathematics teachers' development while teaching in their own classrooms. In particular, a number of in-service education programmes are conceptualised as contexts for integrating theory and practice by involving teachers in undertaking action research in their own classrooms (Cooney & Krainer, 1996; Irwin & Britt, 1999; Jaworski, 1998; Krainer, 1999). However, there is little research on how the teacher deals with the transition between pre-service education and actual teaching. This research is not very encouraging for the mathematics teacher educators as it reveals the difficulties beginning teachers find in making connections with their university experiences (Cooney, 1985; Raymond, 1997). However, these difficulties are mainly attributed to the "reality shock" that the teacher feels during his/her first year of teaching (Weinstein, 1988). Therefore, to study a teacher's development only during the first year of his/her professional life limits our understanding of his/her potential development.

This study aims to investigate the development of the teaching of a primary school teacher while finishing her pre-service education and during her first three years of

teaching. More specifically, we focus on the influence of the particular contexts that this teacher experienced in her teaching practices throughout this time period. We attribute a personal character to the meaning of “context”, considering it as interactively constructed by the teacher through discussion and reflection on action (Jones, 1997).

Methodology

This is a longitudinal case study of a newly qualified teacher, Christina, who has been working in a primary school for three years. The research started when Christina was a student teacher in the last year of her university studies, and continued over her next three years of teaching in the school. We distinguish three strands: the period at the university; the first year of teaching in the school, and the second and third year of teaching. These strands were formed in relation to the kind of support provided to her for the duration of the study. During her university studies, Christina took two courses concerning mathematics and mathematics teaching and learning. In the last year of her studies she did her teaching practice in schools, and participated in an optional course characterised by two general perspectives: the teacher as researcher of children’s thinking and the integration of mathematics and pedagogy (Potari, 1997). In that period the two authors, one being the teacher educator in the course and the other the mentor, supported Christina through discussions during the various activities of the course and while she was planning and reflecting on her teaching. During the first year of her teaching in the school, Christina’s support came mostly from the school; for example, her colleagues and the principal. However, she continued informal discussions about her new experiences with one of the authors and her peer student teacher. In the second and third year, Christina participated in a research project organised by one of the authors (Georgiadou-Kabouridis, 2000). The other author acted as a participant observer in some of the group meetings, a model which has been suggested by Simon (2000). In this case, support was provided mostly through a number of meetings with her colleagues-participants, where the researcher aimed to link theoretical issues about teaching and learning of mathematics to the teachers’ experiences in their classrooms. Support was also given to Christina through discussions with the researcher about her teaching.

Research data consisted of transcripts of videotaped sessions from Christina’s teaching in the first and third strand, transcripts of audio recorded informal discussions and semi-structured interviews between Christina and the researchers in the period of the three strands, Christina’s lesson plans, worksheets and her written comments on the group meetings. Analysis of the data is realised in two dimensions. One concerns what Christina discusses about her teaching and the other what she is actually doing in her classroom. More specifically, in each strand we analyse certain classroom incidents, which are typical of Christina’s interactions with the children. The latter dimension identifies Christina’s teaching approach and reveals possible

teaching development. By linking the two dimensions we explore Christina's awareness of her actions and we investigate how the context affects her teaching.

Christina's typical teaching approaches throughout the three strands

Christina's beliefs about mathematics and mathematics teaching have been investigated in a previous study (Georgiadou & Potari, 1999). In that study Christina seemed to have developed a rather broader view about mathematics than it being "just numbers, rules, exercises", viewing it as "logic, thinking, and a particular way of seeing things", during the last year of her university studies. Moreover, she seemed to have developed an inquiry approach to teaching while interacting with children in the lower grades where she was feeling mathematically confident. Christina viewed mathematics teaching as a process of actual involvement of the children in a variety of activities, and she acknowledged the role of multiple representations in understanding mathematical concepts. This view seems to be consistent throughout the period of the research but it acquired a different meaning in Christina's teaching actions as she experiences the various contexts. In the following analysis we attempt to illustrate the above assumption.

Exploratory teaching

Since being a student teacher Christina has believed in the power and efficacy of activities in mathematics teaching. This view had been expressed in various discussions between her and the researchers but was also evident in her actual teaching practice during her university studies. The following example shows the practical character that she attributed to such activities. In an interview at the end of the course, Christina discussed the following problem that a peer who had taken a third year class, experienced: "A window is 4m long and a door is 2m long. Which one is longer and how much longer is it?" Most children added the two numbers to get the result, although the student teacher read the problem to them many times. Christina judged his approach as inappropriate: "He (the student-teacher) did not realise that the children could not understand the words of the problem. I suggested that he asks the children to represent it. Well, he did so...four children were placed along the window and two children along the door. Then the children gave a correct answer. The problem is that they (her peers) do not interpret children's thinking."

Here, Christina recognises the importance of interpreting children's thinking and their needs in planning appropriate activities. Thus she considered that making the problem concrete for the children could possibly help them to tackle it. Moreover, in her teaching practice in that period, she attempted to get the children involved in activities where her main aim was to encourage them to explore mathematical ideas. The activity acted as the starting point for exploration, which was encouraged by her rather "open" questions. Christina's teaching actions seemed to be influenced mainly by the course where she was expected to act as a researcher. The mathematics classroom was more a place for experimentation rather than a place where the

children had to acquire certain mathematical knowledge. Constraints like the mathematics curriculum; the classroom teachers' goals and time pressures did not seem to be an obstacle to her teaching decisions.

It is somewhat unrealistic to attempt to find “cause-effect” relations between Christina’s university experiences and her teaching actions. However, we can infer that this particular context had challenged existing traditional approaches that she had experienced as a student at school, and helped her at the time of her studies to develop tools for her future professional development. As she admitted: “If I hadn't attended the course I would have continued to teach in a mechanistic way as I was accustomed to in the previous year, where my teaching was based on the textbook and the children could not understand”.

Exploratory versus instructive teaching

Christina’s first year experience has been studied in terms of the way that she conceptualised her teaching role in the school environment (Georgiadou & Potari, 2000). In that study we identified specific elements of the general school environment such as the educational policy of the school, and the important role her colleagues and her former peer student teachers played in Christina’s process of adaptation. In this paper, we will focus on the way that she adapted her view concerning the importance of children’s involvement in activities in this new context. Christina claimed that during that year she was doing a lot of activities in the playground where the children played games with numbers. However, she did not organise classroom instruction around these kinds of activities. From her teaching planning it appeared that she used activities that aimed to inquire into her pupils’ ways of understanding, by getting them involved mostly in written work.

It seems that Christina worked on two planes: the exploratory and the instructive. In the first plane she “transferred” experiences from the university while, in the second, her actions were affected by the reality of the school environment and, in particular, by the restraints of the national curriculum. So, she was striving to see immediate results in the children’s learning, although she was still interested in developing their thinking. In the interview, Christina claimed that she only had 5 to 10 minutes per day for oral activities. She also had a difficult experience at the beginning of the school year: she devoted the whole of the first week to activities and games on preliminary mathematical notions, such as orientation. At the end of the week the principal admonished Christina because parents had complained that she had not done any work because nothing had appeared in their children's homework notebooks. In this difficult year Christina managed to survive and, at the same time, to keep alive her view on how children learn mathematics. This was unconsciously achieved by separating these two planes of work; in some cases, she balanced these two different perspectives of the role of the activities in teaching. For example, while working in the second plane, she realised that the children faced difficulties in

understanding the pairs of numbers adding to ten, from their responses to the written work she had planned based on the textbook. She overcame this difficulty by developing the 'Box' task described in Hughes (1986), which she had used in the context of her university studies.

Discovery teaching

In the following year Christina felt well established in school, as she had gained the approval of the head, other colleagues, the children and the parents, and recognition of her effectiveness as a teacher of Year 1. Thus she was appointed to teach Year 1 for the next two years of the study. At the same time she participated in the research programme aiming at teacher's professional development as described in the methodology section.

During the first year of the third strand, Christina developed independently a large number of activities to support children to understand specific mathematical concepts. In that period the exploratory plane was more a resource for ideas in the planning of her teaching. She realised her instruction through the use of multiple representations and a variety of contexts for the embodiment of the mathematical concepts. The following game that she organised in her attempt to lead the children to discover addition and subtraction as opposite operations demonstrates this approach:

"From this moment the dumb king starts. Nobody speaks. Not even me. We are going to play a game. You need to be very careful. Your eyes open! When I hit somebody's back, she speaks. Now, we start the game. I want you to tell me, using a lot of words, what I am doing."

Using the abacus, she shows ten balls, adds five and then takes away five again. This was quickly repeated several times. She then asked the children to identify the mathematical model, which described this action. Her teaching approach can be seen as "discovery" learning where she expects children to work towards her aims. Talking about her teaching in that year she believed that, "I am better this year than last year in the classroom". She justified this claim by arguing that her children had obtained better results that year although she believed that she was asking them more difficult questions. An explanation for this was that, "The children in this year worked more on written tasks so they were prepared for the tests".

It seems that Christina does not exploit children's thinking in the same way that she used to in the previous strands. Her teaching aims are more result-oriented and the activities she developed were closely related to those aims. Christina's teaching priorities were possibly driven by her feelings of success and the acceptance that she experienced in the broader school environment. However, her view about children's active involvement in the learning process was still apparent.

Reconsidering existed teaching practices

Through her engagement in the group meetings and the individual discussions with the researchers, she started to challenge the effectiveness of her approach. To illustrate this, we present below an extract from a discussion with one of the researchers towards the middle of the second year of the third strand. In this discussion, Christina asked for help to resolve a conflict she faced when her children could not reply to the following sentences:

$\square=1+5$ and $6=1+\square$; although they could solve the sentences $1+5=\boxed{6}$ and $1+\boxed{5}=6$.

In the dialogue below, Ch stands for Christina and R stands for the researcher.

1. Ch: What is happening? And why?
2. R: What are we doing in cases like these? We probably try smaller numbers, change the problem...
3. Ch: You will laugh. I was thinking again of a visual solution, visual representation, you know, as usual.
4. R: Why didn't you try?
5. Ch: Because I wanted to try something different.

Line 3 indicates that Christina is aware of her tendency to use a variety of representations in her teaching. In line 5 she probably wanted to change her approach because it was inadequate for resolving the conflict. This point is further supported later on in the discussion, when she admitted that the following year she would teach that specific content differently. Four days later she came up with three different approaches to the problem. In the first she started with the equality $6=6$, and she planned to ask the children to substitute the numbers with appropriate sums. Another idea was to use two bags, each containing 6 items. Then the children had to choose from a pile of cards with numbers and symbols, and construct sentences to represent the equality of the number of items in each bag. The third idea was to ask children to create a story about $5 + 1=6$ but she rejected this immediately because she was worried that the children would give a trivial word problem from the textbook. In this proposed planning she again acknowledged the role of different representations but it seems that she allowed more space for the children to act. Christina had probably arrived at a certain point where she conceptualised the activity not merely as a means for discovery but as a starting point for mathematical constructions.

Promoting the continuing development of a teacher's practice

The above analysis reveals that Christina formed certain views about teaching and learning mathematics during her university studies. She started building a vision of mathematics teaching different from that which she had experienced as a school student. The latter context supported her in viewing teaching as a process for exploring children's thinking, and provided her with the opportunity to experiment with this perspective. Normal classroom constraints that a schoolteacher faces were not Christina's main concern. So, her desire for "the children to learn" could be fulfilled in this "ideal" situation.

By becoming a schoolteacher she started to experience the disparity between vision and daily classroom reality (Goldsmith and Schifter, 1997). In this new context she felt responsible for children's learning; she wanted to be approved by the head of the school, the parents and her colleagues. At the same time she wanted to develop further her university experience, although this experience was in contrast to the culture of the broader school environment. A way to satisfy all these expectations was to derive elements from both contexts and move in parallel directions. On the one side, she adapted to "established" school teaching practices but, on the other, she was choosing open activities from time to time, just to get children involved and explore their thinking. However, we did not discern many moments in her teaching behaviour where she could integrate these two practices. It is possible that Christina could have found her own way to modify her teaching behaviour in order to reach an acceptable level of harmony with her view about teaching, which was developed at the university. This assumption has been supported in a way by the work of Chapman (2001) who demonstrated that teachers' primary beliefs about mathematics remained unchanged while teaching behaviour was adjusted to those beliefs. However, Cooney (1985) found that a beginning teacher lost his belief that he could try a problem-solving approach in his teaching.

It is difficult to foresee what Christina would have done if she had been operating in the same school context without any further connection to her pre-service mathematics education. In the second and third year of teaching, Christina experienced situations similar to those she had had at the university such as group meetings, reading of research papers, and discussions on the use of materials and about classroom incidents, with her colleagues and with one of the researchers. In these situations the issues discussed emerged from the actual mathematics teaching classroom, yet in some cases, Christina recalled events from the university course that she found to be relevant to those issues. In that period, it seems that Christina reformulated her teaching practice by viewing learning as a process whereby the children discover certain mathematical relations. In this way, she managed to associate the exploratory teaching approach with the instructive but she limited the opportunities for the children to develop their mathematical thinking. The mutual rapport that was developed between her and one of the researchers possibly helped her to reflect on her action and to identify the limitations of her teaching approach.

Concluding Remarks

The seeds for change can and should be planted early in teachers' professional lives, taking advantage of the social contexts in which teachers learn to teach (Cooney and Shealy, 1997, p.92).

The above quotation implies that, especially for the beginning teacher, there is a need for support and feedback in order to foster the continuing development of teaching practices. In Greece, the school context does not promote approaches other than those characterised as "traditional". So, there is a big gap between what the teacher has experienced at University and what he/she faces in the school environment (Potari, 2001). The school environment constrains rather than supports the beginning

teacher to act in accordance with his/her views. The first findings of this study indicate how long and strenuous the process of a teacher's development is and, more specifically, how her view of children's learning was expressed in her teaching behaviour while working in different contexts. Further analysis of the data could reveal other aspects of this process of adaptation.

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