THREE WAY INTERACTION: EXPLORING THE IMPACT OF A HEADTEACHER AND A RESEARCHER ON A NOVICE PRIMARY TEACHER TEACHING GEOMETRY

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This paper is based on the analysis of part of the data collected for my PhD research projection this paper the focus is on one teacher who decided to put aside his teaching method of knowledge transmission in order to undertake an experimental teaching session in his classroom. The role of the researcher in the teacher's decision making as well as the role of the headteacher of the school in inhibiting the teacher's further explorations of his children's ideas are discussed.

INTRODUCTION

Reforms in mathematics education in the Western countries are directly related to the engagement of the mathematical community in inquiring into the nature of mathematics and its teaching and learning (NCTM, 1989, 1991). In this context mathematics teachers educators invite teachers to undertake research activities in their classrooms and reflect on the experiences acquired (Cooney & Krainer, 1996; Jaworski, 1998; Jaworski & Potari, 1998; Simon & Tzur, 1999). On the one hand, absence in Greece of such programmes is obvious. On the other hand, programmes that aim at challenging or even changing Greek primary teachers' traditional practices of teaching mathematics have not been developed yet.

This paper has arisen from the analysis of part of the data collected for my PhD research project concerning the mathematics teaching of a group of Greek primary school teachers. In this paper I focus on one of the six teacher's decision to undertake an experimental teaching session in his classroom. I attempt to analyse the role of the researcher in helping the teacher taking this decision and encouraging him to engage in further investigatory teaching and the role of the headteacher in inhibiting and discouraging the teacher in his first attempt to escape from the traditional system of teaching.

METHODOLOGY

The methodology for the investigation of the whole research project is qualitative and interpretive.

In Peter's case, I used observation for the exploration of his instructional practices, classroom organisation, sensitivity of pupils' needs and treatment of pupils' answers. Data on Peter's mathematical background, his teaching planning and its implementation, his view about his practices were collected through my notes from semi-structured interviews and discussions I had with Peter. Documents concerning

individual work, like Peter's planning of activities and problems, and tests given to the children were also collected.

As participant observer I video-recorded Peter's experimental teaching approach. Both discussions, one between Peter and me before the teaching experiment and the one between Peter, the headteacher and me after it, were audio-recorded. Data collection has included transcripts of the video- and audio-records and my notes and reflections on them.

Peter, the teacher

Peter had completed a four-year programme of studies to become a primary school teacher. His teaching experience in mathematics was based both on his teaching practice in the university and on the tuition lessons he offered to primary pupils. Last year, when I started my research project, Peter was in his first year of teaching in a real classroom. He was the teacher of year 6 (11 to 12 years old). The analysis of the data revealed that Peter applied traditional methods of teaching mathematics

- desks' arrangement in rows
- implementation of the model of the teacher asking a question and one pupil answering
- elicitation of desirable answers
- use of mathematical rules to manipulate children's misconceptions.

Peter speculated about problem solving and particularly about a certain category of problems regarding as problems solved through "reduction to the unit". Later, in the interview, Peter developed his views in details using examples from his classroom experience.

My relationship with Peter could be characterised by mutual confidence. Sometimes he invited me to participate in the teaching session. For example, I discussed with children a child's unexpected question and thus I introduced a model of inquiry teaching. Sometimes he confessed that he did not know other ways of teaching except that of explaining the new concepts on the board and after that calling the children to solve similar exercises or problems.. He was "not satisfied from this way of teaching as he realised children's difficulties in answering his questions", but he claimed that this was "the unique way of teaching he knew that had been acknowledged by every teacher since the beginning".

Peter's experiences from his involvement in my research project revealed to him a world that he ignored. His theories seemed to be challenged, but what about his actions?

The headteacher

The headteacher was charged by the manager of the school to help the teachers in their socialisation in the school and in their teaching in the classrooms. With regard to mathematics teaching the headteacher usually observed a teacher and applied his own

methods of helping him. He intervened during the session and after that he called the teacher in his office "telling him how he should have taught" and "how the teacher could correct his mistakes next time". Moreover, after a few days he visited again the same classroom to make sure that the teacher had followed his instructions.

The headteacher participated in two meetings, where he defended his ideas of basing mathematics teaching on the pupils' textbook as a prevailing vehicle of the national curriculum. Moreover, he claimed that reformed ideas of teaching and learning mathematics were unsuitable to everyday school reality.

ANALYSIS- THE INTERACTION

Before the teaching experiment

The motivation for Peter to decide a different way of teaching, based on the researcher's teaching approaches and on the papers they had analysed in the group meetings, was another difficult for him and for the children teaching session. In this session Peter demonstrated a cuboid and its net and tried desperately to make the children understand the proof of the formula Eπ=Πβ x υ [1] A stressful atmosphere was created and after a short while the children did not pay attention any more. Later, in the discussion we had, Peter claimed: " *..if you were in the classroom earlier, things could be better for me*". I judged that it was the time to propose to Peter to "jump in the deep end ". Peter said: " *OK I'm in. Let's see your way. Besides, I like your way*".

Peter and I collaborated on the planning of the next session, which followed the weekend and in the pupils textbook was entitled "How do we find the volume of a cube". The suggested formula was:

(Volume of the cube)=(area of the base of the cube) x (height of the cube)

A number of exercises and problems should be solved with the use of the above formula.

Peter and I found the whole structure in the textbook rather mechanistic and instrumental. Instead we decided to "open" the lesson by exploring the children's ideas and by deciding on the spot for further targets deriving from the evolution of the whole situation. We planned the lesson setting the objective and relevant tasks: explore the children's concepts of the volume of the cube and the children's ways of calculating the volume by involving the children in constructions of cubes using multilink cubes and by inviting them to estimate the volume of their constructions. Peter could give the tasks, then leave the children work interacting and later invite them to present and discuss their work with their mates. Peter could rather observe the children's work in order to orchestrate the later discussion.

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[1] Eπ is for the side by side area of the cuboid, Πβ is for the perimeter of one base of the solid and υ is for the corresponding with this base height.

As Peter expressed fears of distancing a lot from the textbook and the introduced formula, I proposed an additional task, which seemed to join Peter's reservations and my ideas. For this task we prepared open boxes from transparent plastic, which had square bases and four sides. Calling the children to put in the boxes as many lentils as to construct a cube, we intended to investigate how the children appreciated the role of the height in the construction of a cube.

For the realisation of the above teaching plan Peter and the children of his class moved to the art workroom, the only place in the school that was equipped with tables and chairs, where children could work divided in groups. The headteacher observed the teaching session, which lasted almost one hour, while I video-recorded both group interactions and whole class discussions.

Nevertheless, the analysis of the teaching session could rather be the scope of another paper. Here the focus will be on the ways Peter, the headteacher and myself experienced the teaching experiment and on the discussion among us just after the teaching session

After the teaching experiment

The analysis of the data indicated that the headteacher and I experienced Peter's teaching experiment from different points of view. Actually these points were related to our theories and beliefs of what is mathematics and what is mathematics teaching and learning. On the other hand Peter was found in ambiguous situation. The following analysis addresses the above assumptions.

Although Peter undertook a new role for the first time he managed to manipulate a lot of the difficulties provoked by the children's reactions and achieve his objective. For example, after different groups of children presented their cube constructions, Peter explored in a whole class discourse how children perceived and formulated the notion of the volume of their cubes. Not only he did not reject any child's answer, but also he decided to focus on the less sophisticated answer. Later, in our discussion Peter avowed that the positive atmosphere created in the class because of the teaching experiment and group work, helped poor pupils to express themselves fearless of possible rejection.

Peter recognised that he had achieved his objective and children had constructed the concept of volume through their activities and the classroom discourse. The children had evaluated the volume of their constructions counting the multilink cubes they had used for and relating the result to the length of the edge of their cubes. For example, the group, which had a cube of 64 multilink cubes, observed that the base of their cube had 16 cubes and that there were 4 levels of 16 cubes. Through interaction they concluded that they could find the volume of the cube directly *by multiplying the area of the base of the cube by the height.* Moreover, they applied their conclusion later in the calculation of the volume of the cube with the lentils. However, Peter argued that some children could not calculate the volume of the cube when they were given the length of the edge of a cube. The headteacher claimed that “those children

were the 50% of the whole class". The use of the formula suggested in the pupils' textbook by the children in order to solve problems, like " the edge of a cube is 5cm, what is the volume of this cube?" seemed to be the most important thing for the headteacher.

On the one hand Peter was affected by the headteacher's presence and Peter's judgements of his teaching reflected practically the headteacher's ideas; on the other hand the headteacher encountered opposition to his ideas and felt the need to defend them. For example, I referred to a pupil's idea of considering the lentils as measuring units and asked Peter why he did not develop it. Peter said that the boy was embarrassed and the headteacher agreed with him. The headteacher added that Peter could avoid mistakes if he based his teaching on the textbook first and then he might go on with the activities. Sometimes what the headteacher considered as mistakes I appreciated as challenges for further exploration. For example, one group calculated the volume in cubic centimetres. Their result was not correct as it was revealed by the group's description of their method of calculation:

"*Each side of the cube has 9 multilink cubes; there are 6 sides and that makes 6 x 9=54 cubes; the length of the multilink cube is 2cm, thus the volume of the cube is 54 x 2=108 cm³* "

Peter decided to discuss this group's solution later in the whole class discussion, where he challenged the group's grounds by provoking conflict and led them to the right solution.

CONCLUDING REMARKS

The above analysis revealed that one main reason that prevented Peter from applying reformed teaching approaches was the fact that he ignored them. In the beginning, as a novice teacher Peter felt the need of dependence on an external authority in his pursuit of the right way to teach. On the one hand, the "beaten track" of the knowledge transmission model he had influenced his experiences as a school student had little chance to be challenged dramatically in the university without significant intervention (Lappan & Theule-Lubienski, 1994). On the other hand, this model had been established in his actual teaching under the authority of the headteacher who conceived mathematics as a discipline well constructed by rules and formulas.

When Peter undertook his teaching experiment he made his first step against the authority and towards multisism and relativism. The headteacher exhibited opposition to this step as it controverted to his ideas and to his role of dictating the existing status. Becoming Peter's mentor in the place of the headteacher-mentor is not within my aims. My aim is to support the development of the idea of the inner mentor in Peter towards independence of any authority (Jaworski & Watson, 1994). Cooney et al (1998) assert that the impact of external authority on a teacher decreases when this teacher becomes reflective practitioner. This perspective seems to dominate in my future plans in reverting to Peter and opening his case to further investigation.

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