Facilitating Change in Teachers' Views of Teaching Mathematics

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Abstract. As part of the reform movement the importance of teachers’ professional development has been acknowledged. In this paper we report of the professional development project in Estonia, where mathematics teachers participated in a community of practice. Research on participating teachers’ views of mathematics teaching was carried out. The paper presents an overview of the changes in teachers’ beliefs in a period of one and a half years when they participated in the development project.

Key words: communities of practice, teachers’ professional development; views and beliefs; teacher education.

Introduction

The problems in Estonian mathematics education are well known and commonly recognized. There is a concern of the mathematics educators that mathematics’ programs are overloaded, teaching is too much based on drill-and-practice method and although students’ achievement is relatively good, students’ self-confidence in learning mathematics and valuing of mathematics are low. Most of those problems were clearly reflected also in the TIMSS 2003 results [3].

As the reform movement has called for new kinds of learning and teaching worldwide, the important role of teachers has become evident. In this respect several initiatives have been taken to develop a pedagogical professionalism among teachers and to change pedagogical practice. So far, the main focus of these measures in Estonia has been on teachers’ in-service training. As very little has been changed, it becomes clear that new paths to improve the quality of teaching should be opened. Focus should be directed toward the development of more effective methods for professional development of teachers and changing pedagogical practice. Professional development programs have been popular among policy makers in an attempt to bring forth changes in educational systems [5]. Unfortunately, the effect of such programs has often remained small. Studies on pedagogical reform have indicated that external initiatives have had very little impact when it comes to changing forms of teaching [8]. Today, there is a widespread view among leading education researchers that pedagogical changes cannot be implemented by external fiat. If any real innovation in the pedagogical practice is to take place, a necessary prerequisite is that it be implemented in collaboration with teachers [7].

In 2006 Tallinn University was provided a grant from European Social Fund with an aim to enhance mathematics teaching in Estonia. Project was initiated with an aim to establish teachers’ reflective community of practice, to facilitate and study participating mathematics teachers’ professional development. In our approach, teachers’ collaborative reflection was seen to be the driving force for experiential learning and teacher change.

34 secondary school mathematics teachers volunteered to participate in the project. This group included novice teachers with only two years of teaching experience as well as expert teachers who have already taken responsibility for textbook writing and curriculum development. From the university level six mathematics educators and two doctoral students have been also involved. Project has been in work for three years. Teachers and researchers met regularly to discuss and reflect upon mathematics teaching and learning. Teachers took their problems and experiences out of the classroom using videotapes of classroom teaching, descriptions of lesson plans, field notes etc. Networkings, exchange of experiences and teamwork have been organised [2].

Theoretical Framework and Methods

Professional development of mathematics teachers and more specifically in-service training seems to be an emerging topic of research interest in mathematics education [4]. In recent years teachers’ practice based learning is increasingly attracting the attention of researchers and a number of empirical studies offering different approaches to promote teachers’ practice based learning have appeared. One approach has been to increase teachers’ collective reflection through collaborative communities of university educators and school teachers [see e.g. 4]. This approach is based on Wenger’s (1998) idea of communities of practice. A community of practice is defined by members’ joint enterprise or shared sense of purpose as related to the practice of mathematics.
teaching [6]. In a community of practice it is intended that all participants within the project will engage reflectively in inquiry into their own practices and thus generate new knowledge within the context of their own activity [1]. Such enhancement of teachers’ reflective practices can be seen as the driving force for experiential learning and teacher change.

The aims of present study were to monitor and analyze professional development of the teachers participating in our project. This paper reports on the results concerning the change in teachers’ views of mathematics teaching in a period of one and a half years when they participated in the community of practice. The paper finds answers to the following research questions:

– Whether collaborative reflection of daily practice has an impact on teaching and learning?

– How is that impact reflected in teachers’ views of mathematics teaching?

As the main instrument a questionnaire about teachers’ views was used. The one-page questionnaire contained open-ended questions considering aspects of teachers’ beliefs about mathematics, its teaching and learning. In addition to open-ended questions teachers were also asked to visualize their teaching style by filling in the proper place for it on the triangle describing three main aims of mathematics teaching:

A – learning rules and solving routine exercises;

B – understanding mathematical concepts and ideas;

C – the ability to solve problems and apply mathematics (see Figure 1).

Teachers were asked to fill in the questionnaire during the first meeting of our project (January 2006) and repeatedly after one and a half year of participation in the work (June 2007). During the second survey the teachers were additionally asked to reflect upon the changes in their teaching practice as the result of the project participation.

Results

To the questionnaire we received 23 responses with names and 8 anonymous responses that we were not able to match with the other survey response. So the following bases on the data from the 23 teachers.

As an overall evaluation from the responses, based on our original holistic reading we concluded that the group consisted mainly of teachers regarding themselves as successful who are respected professionals and satisfied with their job.

One possible explanation for that may be that traditional teachers’ in-service courses don’t suite well established professionals. So such teachers lack possibilities for professional development and our offer sounded as a good challenge for them.

When it comes to teachers’ beliefs about mathematics teaching, reflected in teachers’ answers in the first survey, we found three distinctively different views about the aims of mathematics teaching [2]. The first view emphasized routine learning, usually through drill-and-practice type of teaching. This view is apparent in the following quote:

“The curriculum contains a lot of facts to know and skills to master that need to be learnt well.”

“I teach through putting pressure, I demand a lot of practise.”

Another view emphasized the features that characterize mathematics as an axiomatic system:

“Through proving theorems and deriving formulas pupil will learn to think mathematically”

“The goal is that students would comprehend the system of mathematics”

“I feel that mathematics in school is a goal in its own right, mathematics is for mathematics itself.”

The third view focuses on students’ understanding and sees meaningful learning, problem solving and mathematical applications as the aim of mathematics teaching:

“Students need to dare share their own understanding. I aim at giving more weight to solving real life problems.”

“I try making children see mathematics not as only a subject in their exam that determines their future, but as a necessary and very interesting subject.”
The distribution of different views of participating teachers’ is described visually on the Figure 2.

The second survey, carried out after one and a half years participation in the work of our project, reflects remarkable change in teachers’ views.

Predominantly our teachers in their responses stressed much more meaningful learning; also elements of discovery, play and practical tools were repeatedly mentioned in connection with mathematics learning:

- “More emphasis ought to be placed on visualization and finding new teaching aids”
- “Mathematics teaching needs to be made more accessible to students”
- “Problem solving and discovery learning ought to be emphasized”
- “Learning ought to be made more enjoyable and elements of play should be introduced”
- “Non-traditional teaching methods ought to be included”

As can be seen from Figure 3 the distribution of teachers’ views is much more homogenous now.

Teaching practices the teachers reported during the second survey also reflected their changed understandings:

- “I try to apply non-traditional teaching methods”
- “I try to avoid routines”
- “I solve tasks from real-life context”
- “I use more concrete materials”
- “I find ways to get feedback”
- “I use more ICT-technology”

Discussion

There are many mathematics teachers in Estonia who work enthusiastically and creatively to improve students’ learning and to change their understanding of mathematics. At the same time teachers’ are still very autonomous in planning and realising their lessons. Teachers’ work is a lonely job: teaching takes place behind closed doors and each individual teacher has to work out her or his pedagogical strategies independently. They have little insight into their colleagues’ work and it is rare that there is an exchange of experiences. Estonian daily school practice doesn’t encourage teachers’ reflective activities and one may state that professional development is not a part of the school today.

Our project aimed to overcome that problem and to create the environment for participating teachers to share and reflect upon their daily practices but also upon the general aims of mathematics teaching and learning. Via the lectures and seminars given by participating mathematics educationalists deep and meaningful learning, problem solving and mathematical applications as the aims of mathematics education were constantly stressed. Research on participants’ views was able to provide some information about the effectiveness of created community of practice as the mean for participating teachers’ professional development.

According to the results of our first survey carried out in the beginning of the project teachers views about mathematics teaching differed a lot. While some of them emphasized drill and practice others wish to involve more creative approaches to their teaching. After one and a half years participation teachers seemed to have much more unified and different views regarding the aims of mathematics teaching. There was a strongly shared view that it is important to encourage deep learning. Most of them expressed support for discovery learning, practical tasks, problem solving. Learning rules and solving routine exercises as the aims of mathematics teach-
ing were not supported by the participants any more. So the noticeable change of teachers’ views has taken place.

Our study also ensured that teacher’s metacognitive activities could be developed via participation in such projects. In their responses to second survey teachers repeatedly stated the following:

- “I understand the need for collaboration with colleagues”
- “I apply other teachers’ experiences”
- “I analyse my teaching results more than before”
- “I re-think what kind of tasks I use in class”

It is seen that participation in the project clearly encouraged teachers’ reflective activities and developed their metacognition on teaching.

Our study ensured that reflective community of practice comprising university educators and school-teachers proved to be successful in creating change in participating teachers’ views of teaching. As an added value it also developed teachers’ metacognitive skills. It should be stressed that by now we lack information to what extent the change in teachers’ views is reflected in their daily teaching practices.

References

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