Investigating the impact of a developmental research project on teachers' teaching practice: Listening to mathematics teachers' reflections

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The impact of participating in a research project on mathematics teachers' teaching practice is analyzed. Results presented in this article uncover the influence of the research project on many aspects of the teachers' practice and contribute to the development of a better understanding of the complexity of the teaching practice.

Teachers' professional development, implication for teachers' practice, community of practice theory, cultural historical activity theory.

Introduction

The research reported here presents results from my ongoing study concerning the impact on mathematics teachers' teaching practice of a developmental research project , the TBM project (Teaching Better Mathematics), conducted at the university of Agder (UiA) from 2007 to 2010. In the project we collaborated with teachers from 4 kindergarten, 6 primary and lower secondary schools, and 3 upper secondary schools. Our collaboration was organised around workshops where the teachers and researchers from UiA had the opportunity to explore a specific mathematical theme and to engage collaboratively in chosen tasks. In addition each member of the research team had the responsibility to establish contact with the schools and to visit the teachers. The aim of this current research is both to investigate and to categorise the nature of the influence of the TBM project on the different aspects of the teachers' practice. The structure of the article is as follows: first I present the main aspects of the TBM project. Then I explain how the theoretical framework is elaborated and offer a justification of the methodological assumptions. Then I turn to the results of the analysis of teachers' reflections from focus group interviews. I conclude by discussing implications of this research for future programs concerning teachers' professional development.

The main aspects of the TBM project

One of the focuses of the TBM project is to use an inquiry approach to the teaching and learning of mathematics as a means to achieve better mathematical understanding and higher level of competence for pupils. Here an inquiry approach is understood as asking questions and seeking answers, recognising problems and seeking solutions, inventing, wondering, imagining and looking critically both at the tasks we, as learners, are engaging with and at the teaching practice we, as teachers, are adopting (Jaworski et al. 2010). Thereby we use inquiry as a tool to achieve Teaching *Better Mathematics*, that is we seek to develop better understandings of, and competency in mathematics for pupils in school. Likewise, we aim at exploring and developing approaches to *Teaching Better* Mathematics, as a means to achieve our first goal. Our collaboration with teachers is organised according to a co-learning agreement (Wagner 1997). This implies that we recognise both the teachers and our own expertise and, at the same time, we develop a better understanding both of our own world, as researchers, and of the teachers' challenges in their teaching practice. The aim of this article is to uncover aspects of the 'teachers' world' and to explore what co-learning agreement means

within the TBM project. Within the project our collaboration with teachers is organised as follows: researchers from university organise workshops regularly (4 – 5 per year) where a specific mathematical theme is presented during a plenary presentation and then discussed in group sessions as all participants (teachers and researchers) engage collaboratively in some mathematical tasks. In addition, each of the researchers had the responsibility to follow up one or two schools and to visit regularly the teachers engaged in the project, discussing with them the possible implementation in their teaching practice of ideas and tasks, and observing lessons (Berg 2910a, 2010b). In order to gain insights into the consequences for teachers of engaging in the TBM project, focus group interviews were conducted by the project leader from December 2008 to November 2009. In the research reported in this article I am addressing the following research questions:

- What evidence of change in teaching practice can be found in the teachers' reflections from focus group interviews?
- What can we, as researchers, learn from this study?

By addressing these questions, my aim is both to identify and to categorise evidence of change in teaching practice which can be identified in the teachers' reflections. In addition, the results of this research might be useful in uncovering the nature of the challenges teachers met as they engaged in professional development and thereby making visible aspects of their professional world. In the next session I present the theoretical approach underpinning this research.

Theoretical approach

The theoretical approach adopted in this research is rooted in Community of Practice Theory (CPT) with Wenger's (1998) community of practice, where the idea of practice refers both to the teachers' teaching practice at their respective school, and to our own practice as researchers. Furthermore, the idea of inquiry plays a central role in the TBM project and we use the notion of community of inquiry (CoI) as a means to describe and characterise a shift toward critical paradigm (Berg et al. submitted). In our project, inquiry is used both as a tool and as a way of being (Jaworski 2007). Thereby, within the proposed theoretical frame, learning is understood as social participation in practice where mutual engagement, joint enterprise and shared repertoire define the community where the practice is situated. In addition to CPT, we consider Cultural Historical Activity Theory (CHAT) where emphasis is on object oriented activity and goal directed action. At the same time, we consider that it is important to recognise the individual's expectations (Lave 1988). Therefore, I propose to introduce the idea of *convergence between the individual's expectations and the goals of the practice*. As a consequence, teaching development might be understood either as extrapolation, that is as enhanced convergence between teachers' expectations and the goals of the practice, or as expansion, that is as introducing creative innovation that is oriented towards future and transforms the activity system (Berg et al. submitted). I consider that within the adopted framework it is possible to explore in depth the meaning and implications of a co-learning approach and to develop a better understanding of each other "world and its connections to institutions and schooling" (Wagner 1997, 16). In addition since this research aims at studying the implications for teachers' teaching practice of participating in a developmental research project, the data are taken from the teachers' practice and this position follows Ball's (2000) recommendation as she argues that "Instead of beginning solely with the curriculum, our understanding of the content knowledge needed in teaching must start *with practice*. We must understand better the work that teachers do and analyze the role played by the content knowledge in that work" (p.244, my emphasis). Thereby studying the development of the teachers' content knowledge allows me to address the issue of

Teaching *Better Mathematics* and it starts with studying the development of the teachers' practice as reported during focus group interviews.

Methodological considerations

In the TBM project we adopt a developmental research approach. According to Goodchild (2008), central aspects of this approach are as follows: a cyclical process between a development cycle and a research cycle where development nutures research and research guides development. Furthermore, the research cycle consists of a cycle between global and local theories, while the development cycle consists of a cycle between thought experiment and practical experiment. Within the TBM project, global theories refer to CPT and CHAT, while local theory consists of CoI. Furthermore, we understand the development cycle as referring to our engagement with teachers where thought experiment refers to the preparation of the workshops we regularly organise with the teachers (about 4 – 5 per year). Practical experiment refers to the actual realisation of these. Moreover, feedback from participants is informing the next step of thought experiment. While we, as researchers, are engaged in developmental research, as described above, our goal is that the teachers will gradually engage in developing their teaching. This development is referred to as a shift from a *teaching cycle* to an *inquiry cycle*, where this transition implies a shift from planning, teaching, reflecting and feedback to planning *and re-planning*, teaching *and observing*, reflecting *and analysing*, and feedback to the planning step (Berg in press). By focusing on the implications of engaging in a developmental research project, this current research aims at uncovering which aspects of the teachers' practice are modified as the teachers moved from a teaching cycle to an inquiry cycle. Thereby I consider that the adopted approach follows Ball's recommendation to start by investigating teachers' practice.

The research setting

In this current research I analysed focus group interviews, designed as semi-structured interviews, of both primary and lower secondary schools participating in the TBM project. These focus group interviews were conducted by the project leader from December 2008 to November 2009. The aims of the focus group interviews were to offer the teachers the opportunity to reflect on their engagement within the TBM project and to make visible the challenges and the demands they met both at their own school and in relation to the collaboration with researchers as they participated in the project. Each interview was conducted at the teachers' school and lasted for one and a half hour. Two to five teachers were participating in the interviews in addition to the project leader. An important aspect of the focus group interviews concerns the fact that three of the schools also have been participating in a previous developmental research project, the LCM project (Learning Communities in Mathematics) which lasted from 2004 to 2007, while the three other schools have only engaged with the TBM project. All focus group interviews were transcribed and during the process of reading and re-reading the transcripts several codes gradually emerged from the analytical process. These codes were grouped and categories were defined. In the next section I present these categories and the main results from the analysis of the focus group interviews.

Results

After engaging in the analytical process, as described above, the following categories were identified: attitude to mathematics, changes in teaching practice, challenges met by the start of

the project, systemic aspects, cooperation with UiA, and sustainability. Furthermore a salient feature of the analysis relates to the recognition of significant differences between the schools who participated in both projects (LCM and TBM) and the schools who took part only in the TBM project. Particularly the challenges they met and the experiences gained from participating in the projects were expressed differently in these schools. Therefore, it seems relevant to present the results from the analysis according to this dichotomy. For clarity reasons I choose to label the former schools (participating both in LCM and TBM) as "oldtimers", while I refer to the later (participating only in TBM) as "newcomers" to the TBM project. Due to limitation of space in this article I present the results of the analysis related to the following dimensions: attitude to mathematics and changes in teaching practice, and systemic aspects.

Attitude to mathematics and changes in teaching practice

Considering first the three "newcomers" schools, the teachers reported on an increasing awareness concerning the nature of mathematics, they mentioned questions like "what is the nature of mathematics" and "how do I want to present mathematics to my pupils?" In addition several teachers indicated a desire both to become more independent of the textbook and a willingness to look for inquiry tasks, such as the tower in Hanoi. Furthermore, they also reported on and discussed how they tried to modify and adapt already existing tasks, as in textbooks, in order to include an inquiry approach. As these tasks were implemented, the teachers characterised their approach as following an "inquiry spirit", and they reported on a different kind of interaction during the lesson. Furthermore, the teachers explained how inquiry tasks facilitated the communication and discussion between pupils, offering the opportunity for all pupils to explain their own thinking and comment on each others' work. According to the teachers, it was possible to ask questions, to wonder, to have time to investigate a problem. However, a teacher reported on some tension between a desire to involve all pupils in inquiry tasks and the challenge of presenting tasks which are relevant both to low and high achieving pupils. In addition, an important aspect concerned the opportunity, for the teacher, to address mathematical terminology. My interpretation of the teachers' reflections is that they were able to express a desire to achieve convergence between their own expectations, as they participated in the TBM project and aimed at implementing an inquiry approach, and the goals from their teaching practice. At the same time teachers recognised the limitations and challenges belonging to their current teaching practice. Concerning "oldtimers" schools, the teachers reported on engaging with mathematics in a different way and developing a repertoire of tasks they could use and develop further. In addition, they mentioned that they were able to find tasks by themselves. Based on their experience of using an inquiry approach in their own teaching practice, the teachers shared with the project leader their increased awareness of the complexity of teaching. In addition, they observed that the whole culture in class changed, allowing all pupils to participate, including low achievement pupils. According to these teachers, an advantage of inquiry tasks was that all pupils could start with the same task and then move on with different levels of engagement. My interpretation of the teachers' reflections from "oldtimers" schools is that they were able to face the challenges, as described by the "newcomers" schools, and proposed and introduced changes in their teaching practice. Thereby it seems that they were able to achieve a degree of convergence between their own expectations and the goals of their teaching practice.

Systemic aspects

The teachers' reflections concerning this issue show a clear difference according to either belonging to a "newcomers" or an "oldtimers" school. I start by referring to the "newcomers" schools. According to these teachers, a central issue concerned the organisation of the time schedule, and more specifically the possibility to have a double teaching period. Teachers recognised that using an inquiry approach in teaching was time consuming and this recognition implied that time issue became really important. Therefore they claimed that it was necessary to have a different organisation of the teaching schedule, a one which allows for double teaching period, in order to have the possibility to implement inquiry tasks. Another central issue related to how to include colleagues. In each school there was a TBM team including two or three teachers. The challenge consisted of having the opportunity to share with others new teaching approaches and ideas. The issue at stake was about how to organise the collaboration with colleagues at the same school and how to find time to discuss about mathematics and the development of teaching practice. In addition, the focus on mathematics might come in conflict with focus on other subject matters. Finally, the teachers explained that they experienced a tension between, on one side developing an inquiry approach in their lesson, and on the other hand, preparing pupils to the tests. Considering the "oldtimers" schools, teachers' reflections offered an illustration of the way they solved some of the challenges "newcomers" teachers were experiencing. Teachers from all three "oldtimers" schools reported on regular meetings at their school including all colleagues and the school principal. The frequency of these meetings were approximately twice per semester. In addition, teachers from one of the schools reported on a new organisation at their school where a leader group, consisting of teachers from mathematics, Norwegian and English, was looking at ways to implement an inquiry approach to other subject-matters. Some teachers refer to developing and establishing a "new culture" among all teachers at their school. Other initiatives were reported such as establishing contacts between schools participating in the project and inviting and giving information to parents.

Discussion and conclusion

In this article I report on a first analysis of focus group interviews conducted at six lower secondary schools, where three of the schools were participating both in the LCM and TBM projects (oldtimers), while the three others only participated in the TBM project (newcomers). The importance of this distinction emerged gradually from the analytical process and has been used as a dimension in the analysis. Salient aspects of change which has been identified in teachers' reflections and presented in this article refer to their attitude to mathematics, changes in teaching practice, and systemic aspects. Preliminary results show that because of their participation in the project, teachers reported on changes in teaching approach and classroom culture. Furthermore, the deep impact of the project on the school's organisation was made visible since teachers' from "newcomers" schools explained their struggle in achieving convergence between their own expectations in trying to follow an inquiry approach to teaching, and the goals and routines of their practice. Reflections from teachers from "oldtimers" schools reported on how they solved these issues by introducing changes in the organisation of the school, such as a new time schedule, the creation of a team with teachers from different subject-matters, the possibility to organise meetings between all teachers and the school principal where they engaged with and discussed mathematical tasks. Results from the analysis indicate that the establishment of such a team, involving all teachers and the school principal is a key factor in relation to the project's implementation in schools. I consider that these insights, as presented in this article, into the consequences for teachers'

teaching practice of being involved in a development research project are relevant and need to be taken into account for future preparation of professional development projects. More specifically, this research makes visible the deep impact, not only on the teachers' teaching practice, but also on the school's organisation of engaging in a developmental research project. Thereby, this recognition helps us, as researchers, to get a better understanding of the teachers' world and to recognise central issues related to co-learning agreement (Wagner 1997).

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