Inquiry as a Tool and as a 'Way of Being' in Mathematics Teaching Development *

Barbara Jaworski
Agder University College, Kristiansand, Norway

Objectives and significance of the study

Research shows that mathematics teaching in Norway is not achieving the widespread mathematical know-how that society would like to see. The associated presentation from Bodil Kleve outlines recent such research and discusses teachers' classroom interpretations of the Norwegian mathematics curriculum, to explain the Norwegian position.

It is clear that mathematics teaching development is needed, and that this needs to involve teachers. We are moving away from traditional models of in-service development of teachers to a collaborative model based on "inquiry" as a theoretical perspective. With a substantial grant from the Norwegian Research Council (NFR) didacticians are building communities of inquiry with teachers in three levels:

1. Inquiry as a tool for mathematics learning in classrooms

2. Inquiry as a mode of teaching development

3. Inquiry as the basis of a research process to explore the contribution of inquiry communities to teaching development.

Our project is simultaneously a development and a research project. As didacticians work with teachers to develop inquiry communities we study the processes, practices, issues and outcomes of our activity. As teachers design activity for the classrooms, supported by didacticians, we explore the nature of the design process and its progress related to classroom activity. Our chief objective is to learn more about ways in which inquiry processes can contribute to the learning and teaching of mathematics and their development.

Underlying theoretical framework

We see inquiry both as a tool to promote learning and as a "way of being" in a learning environment. Collaboration in inquiry communities develops social processes in which questioning and exploration are central to knowing, and in which interactions take place with mutual respect that builds on the distributed knowing within a community (Cole & Engeström, 1993; Wells et al, 2001, Jaworski, 2003). Design of activity based on theoretical perspectives of collaborative inquiry will lead to innovative activity in classrooms which will be a source of reflection and study by teachers in developmental cycles which are the basis of study in the project (Jaworski, in press). We take the position that "Social science research has the potential to illuminate and clarify the practices we are studying as well as the possibility to be *incorporated into the very practices being investigated*." (Chaiklin, 1996, p. 394. Emphasis added.)

Research design and procedure

In our four year project which began in January 2004, data is collected from interactions between all participants in the project, including didacticians, teachers and students, in workshops at the college, teachers' meetings in school and in classrooms where students learn mathematics. In parallel we are undertaking a longitudinal study of students' mathematical understandings and attitudes and teachers' perspectives on learning and teaching.

A team of about 8 didacticians of mathematics from Agder University College, plus several doctoral students, are working in depth with 7 schools across the full age range, with a minimum of three teachers from each school as full participants in the project. Workshops at the college start the process of community building and developing inquiry as a way of being. Teacher groups in school, supported by didacticians, design innovative activity based on inquiry processes and collaborate on developing inquiry in their classrooms.

We are using quantitative and qualitative methodologies, including surveys, interviews, classroom observation and analysis of discourse. Multimedia methods of observation and analysis will contribute to findings.

The first 6 months of the project has involved recruitment of and early negotiations with schools, planning of workshops at the college, and consideration of our joint activity with teachers in schools. We, didacticians,

* This paper is linked to Bodil Kleve's paper. See p. 85.

have had to build first our own community. From diverse backgrounds, we worked collaboratively to design a research proposal based on the interests and expertise of all in our group. The proposal was one of seven to be funded in a special research programme of the NFR; however, the allocated funding was substantially less than our budget, so our programme had to be trimmed quite severely. On receiving funding our first step was to recruit doctoral students whose research would be part of the programme. Programme re-negotiation and early work with our doctoral students allowed us to address theoretical perspectives and to develop awareness of issues in putting theory into practice. Collaborative planning for workshops, some involving teachers, has led to addressing questions and dealing further with issues.

Findings

It is interesting to observe how methodology runs into findings, since our methodology develops along with activity in the project. For example, one of our objectives was that workshops should be a vehicle for building an inquiry community with teachers through which inquiry-based design of classroom activity could take place. It seemed fundamental that we should work together on mathematics in inquiry mode. The nature and style of mathematical tasks became therefore a focus of concern. What kinds of tasks or problems could initiate inquiry thinking and lead to ideas for classroom inquiry?

At the time of writing we have just held our first workshop using such tasks. We will report on outcomes as reflected in our data and analysis. Simultaneously we are analysing data from earlier meetings (audio and video recordings) to gain insights into our own processes (as didacticians and researchers) of community building and associated inquiry. We will report on and from this analysis.

To provide baseline information about students' mathematical competence, we have designed mathematical surveys to assess students in grades 4, 7, 9 and 11. Attitude surveys and interviews are currently being designed to enhance our baseline data. We are dealing currently with issues regarding the philosophical basis of such surveys and its relationships with the inquiry nature of our project.

Dealing with multiple data sources and approaches to data collection and analysis is proving challenging within the project. We will report further on such challenges.

By the time of the conference, we will have data from the early work in schools between teacher teams and supportive didacticians and will have begun analyses. We will report from this work. At that stage we shall not yet have undertaken a study of innovative activity in classrooms as a result of the design process. We must leave that to report at a subsequent meeting.

References

Chaiklin, S. (1996) Understanding the Social Scientific Practice of Understanding Practice. In Chaiklin, S. & Lave, J. (Eds.) *Understanding Practice: Perspectives on Activity and Context.* Cambridge: Cambridge University Press.

Cole, M. & Engeström, Y. (1993) A cultural-historical approach to distributed cognition. In G. Salomon (Ed.), *Distributed Cognitions: Psychological and educational considerations*. Cambridge: Cambridge University Press.

Jaworski, B. (2003b) Research Practice into/influencing Mathematics Teaching and Learning Development: Towards a Theoretical framework based on co-learning partnerships, *Educational Studies in Mathematics*. 54, 2-3, 249-282.

Jaworski, B. (in press) Mathematics Teaching Development through the design and study of classroom activity, Papers of the British Society for Research into Learning Mathematics*, Research in Mathematics Education.* (Vol. 6).

Wells, G. (Ed.), (2001) *Action, Talk and Text: Learning and Teaching Through Inquiry.* NY: Teachers' College Press.