

## **TBM at AUC**

### **Main aims/goals of the TBM project at AUC**

To develop knowledge and practice in the teaching and learning of mathematics, so that pupils in schools have better learning experiences and achieve better conceptual understandings of mathematics. Pupils should demonstrate a fluency with mathematics based on deep understandings.

#### **Mathematics learning and teaching**

We draw on knowledge from research in mathematics education in a wide range of areas. Firstly knowledge of the learning of mathematical concepts and the strategies and errors that are common to pupils' work (Hart, 1981). Secondly a wide range of thinking and findings in areas of mathematical problem solving and its contribution to learning of mathematics (Polya, 1945, Mason, Burton and Stacey, 1982; Schoenfeld, 1985). Thirdly, we believe that learning results from pupils' ownership of mathematics questions and ideas, and that ownership comes through active engagement in the classroom, discussion and negotiation of mathematical ideas with peers and teachers, and critical questioning of mathematical concepts (Burton, 1984, Jaworski, 1994; Stigler and Hiebert, 1999). The L97 curriculum emphasises these factors and we inquire into ways in which curriculum ideas and objectives can be achieved (The Royal Ministry of Education, Research and Church Affairs, (1999). Fourthly we draw on research in mathematics teaching and teacher education to use the findings in our construction of activities in which to engage teachers and didacticians for development of common understandings and enhanced practice (See articles widely in the *Journal of Mathematics Teacher Education*).

#### **Inquiry communities**

We build on research knowledge of inquiry communities generally and on what we ourselves have learned from our KUL research. Inquiry in practice is not well defined. We are building on theory and research to recognize key features and characteristics of inquiry in our local communities in schools and the projects as a whole (Wells, 1999, 2001). This is raising important issues about the levels of involvement of the various participants and their respective ownership of questions and issues. The nature of partnership between teachers and didacticians has been central to our research (Jaworski, 2004b; 2005). Ways in which teachers see themselves as inquirers, and their dependency on didacticians have emerged as key to development. The roles of didacticians in promoting teacher and teaching development have figured strongly in our research (Cestari et al, 2005). For example, we see that teachers need a more well-founded ownership of developmental goals, in order to stimulate their activity and motivate their sustained involvement despite many demands of school life. This needs to form a more equitable basis for teachers and didacticians in motivating and taking responsibility for activity. Didacticians need to be able to respond to what teachers need most of their expertise, in ways which teachers will judge according to what they want from the project. We have to develop our inquiry communities to achieve a mutuality in which there is a dialectical reciprocity between the roles and goals of teacher and didacticians.

## **Research and Inquiry**

We engage in *developmental research*. By this we mean research that both studies the nature and outcomes of the developmental process and also promotes development (Jaworski, 2003). Research has an important *design* element (Wittmann, 1998; Kelly, 2003, Cobb et al, 2003). We design activity at a range of levels, explore the use of what is designed, reflect on its outcomes and feedback to improve the design. This cycle of developmental design operates both in planning for classrooms, the associated mathematics tasks and teaching of mathematics, and in the design of workshops through which to promote thinking and development of didacticians and teachers in planning for teaching (Marton et al, 2003; Wood & Berry, 2003; Jaworski, 2004b). The design cycle is fundamentally an inquiry process in which questions are explored in creating designs and relative to the outcomes of designed activity (Cochran Smith & Lytle, 1999). We collect data from every aspects of the design and implementation process, and analyse this data according to a set of project research questions. Publications result from research analyses and from reflective engagement in development and research.

### **All participants are researchers**

In our current and proposed work, both didacticians and teachers are researchers. The research in which they engage can be seen as motivating the kinds of thinking and analysis which emerge. Both engage in *insider* research. This involves research into their own activity and practice for the purposes of learning more about that practice and hence having the possibility to improve their own practice (Elliot, 1991). In addition, didacticians act as outsider researchers, gathering data and exploring development within the project as a whole. In doing so, they look critically not just at their own practice, but the activity of others within the project. For example they would gather data from teaching in classrooms or from interviews with teachers or pupils and analyse this data with respect to questions about learning and development. Insider and outsider forms of research are complementary in providing knowledge in the project and promoting development (Bassey, 1985).

### **Teacher education**

The KUL projects only just began to include teacher education as part of their study and development. Didacticians worked with one group of student teachers to engage them in developing tasks for inquiry in their practice schools with feedback to the project. In the proposed project we plan to make teacher education more central to our activity. This will happen at two levels. First we will draw teacher educators into our didactician community, introduce them to ideas of inquiry communities and help to build theory of inquiry communities into the course material for student teachers. Then, in practice in their school placement, we will offer activities for student teachers to engage in learning through research. . This can take place in several modes 1) they can have explicit research tasks to carry out in their placement schools; 2) they can get involved in the school with teachers' developmental work within the project; 3) they can have tasks for the classroom in which they support the project in developing inquiry activities with pupils. Results from all of these modes of action can feed into a portfolio for each student teacher showing their learning within the teacher education programme. These portfolios will also be important data within the project.

## **Relationships with schools**

### **Schools determine their developmental goals**

We expect to work with a number of schools who are partners with AUC in teacher education or research programmes. Through their school owners, these schools will bid for their funding from various sources to support developmental work in the school.

Didacticians at AUC will help the schools in formulating funding proposals based on ideas of inquiry and community. Each school must propose its own goals for developmental work. It is very important for the AUC TBM project that the schools set the basic agenda for the project. Activity within the project will develop from school agendas as indicated below.

### **Didacticians help with formulation of goals**

The AUC team has had several meetings with proposed schools. Schools have been informed about the KUL projects and about developmental and research activity in these projects. There has been opportunity for schools to ask questions about this work and to start to formulate their own thinking for developmental activity in mathematics teaching and learning. Didacticians have offered to read and comment on school proposals and offer advice if requested. However, the AUC team has tried to make clear that it is very important to start from schools own wishes for development.

### **Teachers and didacticians develop mutual roles**

At the start of the project, we expect different schools to have different starting points for developmental activity. The project will involve first a sharing of plans and developmental goals from the schools. Didacticians will enable the sharing process, ask questions, encourage schools to initiate activity and take part in that activity according to negotiations with each school.

### **The activity of the project**

The start of the project has been complicated by the fact that none of the schools that applied for funding through the Skoleutviklingsprosjekt was successful. Thus, initial activity has involved schools in formulating further proposals to funding organizations, with didactician support. Activity with schools cannot start until the issues of funding are resolved. Once the position is clearer, then activity can begin.

### **Initial activity in schools**

Schools will have declared their own plans for development with their own developmental goals as indicated above. To some extent, preparing the proposals for funding will have facilitated this declaration of goals. There will be ongoing work in schools discussing their plans and setting up possibilities for putting plans into operation. Groups of schools with the same school owner may form a small consortium with shared aims. Didacticians will be available for consultation if asked.

### **Initial activity in the college**

Didacticians will start planning for work with schools and becoming familiar with what schools have planned. Project staff will be recruited: plans are for three doctoral stipends,

one of which has already been appointed. We shall delay work in teacher education until school activity is well under way.

### **A starting workshop**

In our joint activity with schools, we shall first hold a workshop with teachers from all the schools and didacticians. Schools will present plans for their projects. There will be questioning and discussion of the proposed plans in large and small groups. Discussion will then focus on the nature of activity in schools and expectations for development. We will consider jointly how didacticians can support development and how research data will be collected. Teachers' roles as researchers will be an important part of this discussion.

### **Subsequent meetings or miniconferences**

We expect to plan a programme of meetings/workshops for sharing ongoing work from the schools projects, processes and issues from developmental practice and aspects of research. These may involve all schools together or selected grouping of schools as these emerge. We will meet at AUC, in particular schools or in regional centres.

### **Mathematics workshops**

We expect an important part of this project to involve provision for teachers to upgrade their own mathematical knowledge. This will be initiated through consultation with schools and teachers about perceived needs. Workshops or minicourses will be mounted according to needs. Web-based materials may be constructed, and we will draw on other such provision and existing resources. Didacticians will work with teachers in ways appropriate to locations and needs.

### **Teacher Education**

When work with schools is well under way, we shall start work with teacher educators putting in place the course-related aspects of our plans for the teacher education goals within the project. This will build on research with student teachers begun in the KUL projects using materials from the longitudinal study. Ultimately we see student teachers being engaged with project teachers in inquiry activity in classrooms related to school goals.

### **Research and research training**

According to stated goals that all participants will be researchers in the project, didacticians will organise research training sessions for teachers either in individual schools, local centres or at AUC. Here we will introduce the developmental cycle of design/action/reflection/feedback mentioned above and help teachers to see how they can undertake such activity and keep records from it. The keeping of records at different levels will be seen as central to the project and teachers will be helped with developing means of writing their reflections and keeping a range of records.

Didacticians will collect data as far as possible from all activity for formal analysis. We will use the complex data collection structures we have put in place as part of the KUL projects, and continue the building of data banks for ongoing and future analysis.

### **Publication ongoing, developmental and research**

All research writing should lead to publications. These will take a wide variety of forms from local reports, through short articles in professional journals to more scientific articles in research journals. Teachers and didacticians will make presentations at conferences locally, nationally and internationally. A book or books will be written to capture the developmental processes, issues in establishing inquiry communities, outcomes for teacher and pupil learning, and knowledge about the improvement of mathematical learning in schools.

### **Evaluation of ongoing activity**

Evaluation of practices will be ongoing with developmental activity. We will plan an external evaluation of the project half way through so that it can influence project completion.

### **Project management**

Project management at local levels will fit within the overall management of the TBM project through the consortium. Local structures will be put in place to support the overall management structure

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