

## **KappAbel: Change of attitudes and practices?**

Tine Wedege, Roskilde University, Denmark

“All of the above activities [mathematical competitions of various kinds] have a positive effect, direct or indirect, on the teaching and learning of mathematics and in attracting students to the study of mathematics.” This statement stems from the policy paper of the World Federation of National Mathematics Competitions (WFNMC, 2002). In Discussion Group 16 (The role of mathematical competitions in mathematics education) at ICME-10, the Organising Team has decided to focus on two questions: “(1) Do mathematics competitions contribute to widening the gap between mathematics for all and mathematics for the elite, or can the opposite be the case? (2) How can competitions motivate and foster mathematical creativity with students at large?” The Nordic Contact Committee of ICME-10 has formulated a call for research projects on the mathematics competition KappAbel that should address significant questions about results of the competitions, in particular “possible changes in student attitudes towards mathematics, as well as possible changes in the practice of involved teachers”.

WFNMC describes the overall positive effect of mathematical competitions. DG16 has focused on two possible results of competitions and the same has NCC. In relation to mathematics education, the crucial issue seems to be something like this: Do competitions contribute to the change of attitudes and practices – or are they just an isolated period of concentration, joy, anxiety, challenge and fun with no consequence for mathematics education? It is obvious that these questions cannot be answered without taking the context into account – the specific design of the competition and the mathematics education environment.

The door named mathematics in education and jobs is experienced as closed to many people. A summary of many adults’ relationships with mathematics has been formulated in a single sentence: “Mathematics – that’s what I can’t do.” (Wedege, 2002). From a broad perspective, people’s attitudes and self-perception in relation to mathematics may be socially generated through their lived experiences. However, I claim that this belief in adults is primarily a result of teaching and learning mathematics in primary and secondary school (Stark and Ravnborg, 2001). The apparent contradiction between many adults’ barrier in relation to mathematics in formal settings and their competences in everyday life has puzzled me for years. The Nordic competition KappAbel is not a competition in the traditional sense, as it is based on collaborative project work in rich task-contexts in school classes, and it might potentially create a situation context for changing young people’s attitudes to mathematics (Wedege, 1999). This potential has been the driving force for me in the work with this application.

### **Objective and background**

The official aims for KappAbel can be divided into two parts: (1) to influence the students affective relationships with mathematics (beliefs and attitudes) and (2) to influence the development of pedagogy of school mathematics. To go from individualism to collaboration and to show that mathematics is more than one right answer; that it is also discovery, creativity, curiosity and collaboration. In relation to

these aims the organisers believe that the project work and the specific form of competition will contribute. In harmony with current developments in mathematics education, this could be formulated as a change from mathematical products to mathematical processes in mathematics classrooms (Skott, 2000).

The main objective of the research project *KappAbel: Change of attitudes and practices?* is to investigate potential results of the competitions measured in terms of possible changes in participating students' affective relationships with mathematics and in the teachers' classroom practices. In addition, the teachers' intention with participating in the competition will be mapped.

KappAbel is a Nordic mathematics competition for pupils in their 9<sup>th</sup> year of schooling (pupils in 8th grade in Denmark, Finland and Sweden, and in 9th grade in Iceland and Norway). It is a competition based on collaborative project work in school classes: when a class has registered, the whole class counts as ONE participant. The competition starts with two web-based qualifying rounds in November (1a) and in January (1b). The problems are to be solved by the whole class within 100 minutes at some time during the two weeks the site is open. In Norway the qualifying rounds is a competition within each fylke (county) and one of the classes continues to the semi final where a project with a given theme is an important part. The theme for 2004 was "Mathematics and music". The four students (two boys and two girls) from the three best classes after the semi final meet for the national finals. (Sources: [www.KappAbel.com](http://www.KappAbel.com) and Holden, 2004)

WFNMC (2002) makes a distinction between the following two categories of mathematical competitions: (a) *Inclusive competitions* are of a popular nature, designed for students of all standards, and certainly accessible to the student of average or below average standard. Such competitions give each student the opportunity to solve simple though often intriguing problems set in familiar circumstances. These competitions will not usually be set according to a published syllabus. Examples: Multiple choice competitions and first rounds of National Olympiads as they are held in some countries. (b) *Exclusive Competitions* are aimed at the talented student. Once again the syllabus of the competition is rarely formal. But the subject of mathematics being so broad, there is vast material of a challenging nature which enables students to deepen their knowledge and command of mathematics without the need to accelerate their study. Examples: National and International Olympiads in Mathematics.

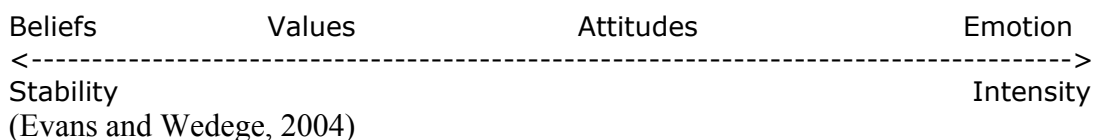
In Norway, two mathematics competitions are named after Niels Henrik Abel: the Abel contest and KappAbel. *The Abel contest*, which started in 1980, is a contest in mathematical problem solving for high school students. It consists of two rounds and a final. The winners in the final automatically qualify for the International Mathematical Olympiad. The first round of the Abel contest is an inclusive competition while the second round and the final are exclusive competitions. It is obvious that KappAbel is designed to be an inclusive competition.

KappAbel has developed from a national (Norwegian) to a regional (Nordic) competition involving all the Nordic countries. Already in 2001, 10.000 students participated in the first rounds in Norway. It is reasonable to talk about a developed practice. Thus the empirical investigation of the research project will focus on the Norwegian experiences.

### **Theoretical framework**

This project will concentrate on the affective dimension of students' and teachers' relationships with mathematics, which interacts with the cognitive and social dimensions. We will understand *attitudes towards mathematics* broadly as people's

affective relationship with mathematics comprising three dimensions: beliefs, attitudes and emotions. *Beliefs* include conceptions of mathematics, self-perception (e.g. “Mathematics - that’s what I can’t do.”), aspects of ‘identity’ (e.g. “We - the semi-skilled workers - not using mathematics versus “the others” using mathematics), and confidence; and *attitudes* (e.g. maths anxiety) are more stable than *emotions* (e.g. panic or joy) (McLeod, 1992; Evans 2000, Wedege, 2002). McLeod (1992) suggests that these can be positioned along a spectrum that runs from *stability* and “cool” on the left, to fluidity and *intensity* on the right:



Within this conceptual framework beliefs are more stable than attitudes that again are more stable than emotions. We can also position other associated concepts on this spectrum, for example, *values*.

In his analysis of Western Mathematics, Bishop (1988) based his work on the theory that all cultures (including mathematics) comprised the three dimensions ideology, sentiment and sociology. He “identified six different sets of ideals and values which relate to these three components, in complementary pairs”: rationalism vs. objectism; control vs. progress; and openness vs. mystery (Bishop, 1988:61). Bishop’s analysis presupposes a certain approach to mathematics. His research questions could not be posed or answered in a value-free approach to mathematics. In the Values and Mathematics Project (VAMP) values in mathematics teaching have been investigated in order to make them explicit. Here the values are defined as the “deep affective qualities which education fosters through the school subject of mathematics.” (Bishop et al., 1999:3).

According to Bourdieu’s theory, *habitus* (a system of dispositions generating practices and representations) undergoes transformations but otherwise durability is the main characteristic (see Wedege, 1999). Thus we claim that changes in teachers’ and students’ attitudes towards mathematics – in the cognitive end of the spectrum – are not to be expected as a result of a mathematics competition like KappAbel.

This is also why we will understand *changes in the teachers’ mathematics classroom practices* as changes in the didactical contracts (the implicit contract between students and teacher that exists in a specific form in every classroom) (Brousseau, 1986). A change in the teachers’ practice isn’t merely a change from individual work to group work or a change from mathematical tasks to project work. We also want to make issues like “Learning, knowing and doing mathematics, what does it mean?” explicit in the project.

### **Methodology**

The research questions concern potential results of KappAbel in forms of possible changes in attitudes and practices. This involves three kinds of methodological problems. Firstly, the project period is very short and we will at most observe tendencies and sign of beginning changes as results of the competition. The transformative learning processes in focus will not be observable after one or two months (cf. Illeris, 2003). Secondly, there isn’t any straightforward relationship between teacher belief and practice (Skott, 2000). Thus it will be necessary to make the distinction between ideal and real teaching of mathematics explicit in questionnaires and interviews (cf. Pehkonen and Törner, 2004). Thirdly there might be an interesting

conflict between the teachers' and students' attitudes towards mathematics expressed in their own words and the researchers' words expressed in a questionnaire (Henningsen and Wedege, 2003, Wedege and Henningsen, 2003). This is one the reasons why the project will combine quantitative and qualitative studies. Another reason is this is offering the possibility of triangulation in data gathering.

A survey among all teachers participating in KappAbel, 2004-2005, on their attitudes and classroom practices, including their intentions to participate in the competition. On the basis of this survey, teachers from two counties are chosen for qualitative, semi-structured interviews. Students from the same classes are interviewed in groups on their attitudes and experienced classroom practices before and after the competition. Observations (non-participant) are made in the same classrooms during project work and one month later. (Are the classes doing thematic work or mathematical project work?(see Torkildsen, 2000)). In the interviews and during observations, gender will be one of the specific points of attention.

### Time schedule

The KappAbel competition (2004-05) and the project period are setting a tight framework for the research project:

	<b>KappAbel</b>	<b>Research project</b>
<b>2004</b> August September October November December	The theme is published  Qualifying round 1a	Design of questionnaire Pilot (teachers) 1. Group interviews (students) Observations – Survey (teachers)
<b>2005</b> January February – March April May June ---- September October	Qualifying round 1b Project work: 2. round Semi-final (national)  Final (Nordic)	Handling and analyzing survey data Observations – Design of interview guide Observations – Interviews (teachers) 2. Group interviews (students) Observations – Data analyze  Draft report Final report

### Research group and cooperation with NCME

Tine Wedege (see enclosed C.V.), Roskilde University, is the project leader. She will work in NCME, NTNU, Trondheim, in periods of one to five weeks, August 2004 to June 2005. The Norwegian research assistant will be connected with NCME. Inge Henningsen (Professor in Statistics), University of Copenhagen, will assist in handling and analyzing of the quantitative data from the survey. Jeppe Skott (Ph.D. in mathematics education), the Danish University of Education, will be a reference person on design and data analysis. Ingvill Holden (professional leader of NCME) will be an important reference person to the project and she will create the necessary contacts to counties, schools and teachers.

The grant of 250.000 DKR from NCC will be administered by NCME, who will house the project and cover additional expenses (see enclosed budget).

## Presentation of results

A paper with preliminary findings will be presented at the Nordic Conference on Mathematics Education, NORMA 05. A written report in Danish/Norwegian will be published at NCME shortly after 31 October, 2005, and a short article for the Nordic mathematics teachers' journals. On condition on further funding for the project, an article will be submitted to the international journal "Mathematics Competitions" and to the journal "Nordic Studies in Mathematics Education" (in Danish).

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