RESEARCHING POTENTIALS FOR CHANGE:
THE CASE OF THE KAPPABEL COMPETITION

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This paper reports on the design and methodology of an ongoing study in belief research. The study addresses the question of the potential and perceived influence of the KappAbel competition on the mathematical attitudes and practices of the participating teachers and students. We shall outline our main methodological considerations and also discuss, and to some extent challenge, what we consider dominant approaches to research on teachers’ beliefs. We address three interconnected methodological difficulties: (1) the problem of not using conceptual frameworks that are well grounded empirically; (2) the question of overemphasising teachers’ views of mathematics for their educational decision making; (3) the problem that no terminology carries unequivocal meanings and more than an indication of agreement or disagreement with the rhetoric of reform is needed to outline teachers’ and students’ school mathematical priorities.

In this paper we shall discuss the main methodological problems of a study that we are currently conducting. The intention of the study is to develop an understanding of if and how the KappAbel mathematics competition has an influence on the beliefs and attitudes and the teaching/learning practices of the participating teachers and students. This is a question that is closely related to the more general one of the role of external sources of influence on teaching/learning processes: What may initiate and sustain change in mathematics classroom practices and in students’ and teachers’ beliefs and what – if any – is the relationship between the two sets of changes? As the point of departure in this study, we claim that people’s relationship with mathematics is developed in different communities of practice (family, school, working life, etc.) however the practice of the mathematics classroom is the most significant of these communities (cf. Wedege, 1999).

It is not our intention to discuss any substantive findings of the study, as it is still ongoing. Instead we shall outline our methodological approach and in particular elaborate on our attempt to address what we consider three significant problems of mainstream belief research. These are the problems of the lack of empirical grounding of the involved constructs of mathematics; the one of a possible overemphasis on mathematics in most research on teachers’ beliefs; and the one of ambiguities of the terminology used. In addition to discussing how we have dealt with these problems, we shall discuss some general difficulties related to surveys and qualitative interviews. However, we shall start off with a short presentation of the KappAbel competition.
1. THE KAPPABEL COMPETITION

KappAbel is a Nordic mathematics competition for pupils in lower secondary school. The overall aims of the competition are (1) to influence the students’ beliefs and attitudes towards mathematics and (2) to influence the development of school mathematics. KappAbel is based on collaborative work in whole classes: the class counts as one participant. The competition begins with two web-based qualifying rounds of joint problem solving activity. The problems are to be solved by the whole class in 100 minutes. In Norway, one class from each county continues to the semi-final. Before meeting for the semi-final, these classes do a project on a given theme e.g. mathematics and music. The project is presented in a report, a log book and at an exhibition at the semi-finals. Each class is represented by a group of four students (two boys and two girls) who are to present the project work orally and to solve and explain a number of investigative tasks. The groups representing the three best classes at the semi-final meet for the national finals, where they are to do more non-routine, investigative tasks.

KappAbel, then, focuses on investigations and project work and signals that mathematics does not consist merely of closed lists of concepts and procedures with which to address routine tasks. Also, the emphasis on collaboration in whole classes suggests that there is more to mathematical activity than individuals engaging the development or use of such concepts and procedures. In this, KappAbel seems to be in line with international reform efforts.

The study reported on in this paper seeks to contribute to an understanding of the extent to which KappAbel meets the aims mentioned above.

2. CHALLENGES TO RESEARCH ON BELIEFS AND ATTITUDES

Research on teachers’ beliefs has developed into a significant field of study, attempting to improve present understandings of (i) the character of teachers’ beliefs, (ii) how these beliefs develop, and (iii) their possible connection to the classroom practices. Mainstream belief research claims that (student) teachers’ beliefs are fairly resistant to change. However, it also suggests that they may develop in line with the reform, if pre- and in-service teacher education programmes model the types of teaching envisaged in reform documents and involve the participants in long-term collaborative efforts to develop the practices of their own classrooms through continued reflection. Also, there seems to be some consensus that teachers’ beliefs play a considerable role for the learning opportunities unfolding in the classroom. Making and applauding this last point, Wilson and Cooney (2002) claimed that there has been a tradition of basing

“research on teachers’ beliefs […] on the assumption that what teachers believe is a significant determiner of what gets taught, how it gets taught, and what gets learned in the classroom.” (p. 128)
For the larger part of belief research, then, there seems to be an expectation of a positive correlation between beliefs and practice, with the former determining or significantly influencing the latter.

However, belief research has also been subject to a combination of methodological and substantial criticism in recent years. This criticism has challenged its implicit or explicit premises. Lester (2002) raised a radical methodological criticism. He pointed to the risk of research on belief-practice relationships becoming a self-fulfilling prophecy, because of its circular argument of claiming that certain observed mathematical practices are due to beliefs, while at the same time inferring mathematical beliefs from very same practices. The problem Lester refers to seems to stem from an agreement in much belief research that espoused versions do not have a privileged position as an entry point to understanding beliefs. Beliefs are often conceived as propensities to engage in certain practices in particular ways under certain conditions (e.g. Cooney, 2001, p. 21). Consequently they are often inferred from observations of the practices in question. Lester’s point, then, relates to a situation in which the call for different methods in belief research is confounded with a type of methodological triangulation that assumes identity between objects researched with different methods. We shall return to this issue later.

Lester made the above point in relation to students of mathematics. If reinterpreted so as to relate to teachers it is in line with the first author’s criticism of mainstream belief research (e.g. Skott, 2001b). Skott questioned the tendency to use teachers’ beliefs as an explanatory principle for practice. The general affirmative answer to the question of a possible positive correlation between teachers’ beliefs and the classroom practices appears to be a premise rather than a result of belief research. This is so in spite of occasional calls to look into another and less researched question of a possible opposite relation between practice and beliefs (e.g. Guskey, 1986). Skott’s criticism challenges the tradition in belief research that Wilson and Cooney later described (cf. the quotation above).

Also, a rather more substantive criticism of belief research has been raised, especially of the highly individual approach normally adopted. Lerman (2001; 2002) has argued that although there may be ‘family resemblance’ between the views of school mathematics expressed in research interviews and those held in the mathematics classroom, they are qualitatively different entities. Skott (2001a) argued that a social perspective is needed that acknowledges that the objects and motives of the teacher’s activity emerge from the interactions with specific students in the specific classroom. Further developing the argument, he pointed to the teacher’s involvement in multiple, simultaneous communities of practice each of which frame certain aspects of the teacher’s activity, and claimed that beliefs of mathematics and its teaching and learning played variable roles in different contexts dominated by adherence to each of these of communities (Skott, 2002).
These two sets of criticisms – one primarily methodological, the other primarily substantial – are interconnected and share a concern for the risk of creating or assuming the existence of an unambiguous object of study (students’ or teachers’ beliefs) that may be alien to the students and teachers in question and the significance of which is presumed rather than investigated. We shall elaborate on more specific aspects of these criticisms below and describe ways in which we have tried to take them into consideration within the time frame available for the KappAbel study.

3. METHODOLOGICAL DIFFICULTIES IN THE KAPPABEL STUDY

It is apparent from the introductory description of KappAbel that the competition seeks to influence the immediate teaching-learning practices of the participating students and teachers as well as their beliefs and attitudes towards mathematics. It does so by suggesting reformist classroom processes that are not necessarily in line with those that normally dominate the classrooms in question or with the teacher’s general school mathematical priorities. This is different from attempts to develop teachers’ beliefs for instance through pre- and in-service teacher education. In the latter cases, the expectation is often that a change in an independent mental construct of beliefs will subsequently inform teaching-learning practices, as the teacher ‘carries’ her reformed attitudes to school mathematics into the different setting of the mathematics classroom. In contrast to this, KappAbel seeks to have an immediate impact by inserting a different set of teaching-learning practices into that setting by structuring the prevailing type of collaboration and by determining the types of task to be used. This is the first of KappAbel’s intentions as described in section 1. The other intention may be rephrased as an attempt to capitalise on the part of the reciprocal belief-practice relationship that has so far been researched the least, i.e. the one from practice to beliefs. In these terms the intention is to influence teachers’ and students beliefs and attitudes through an imposed set of changes in collaborative structure and types of task.

One aim of the present study is to shed some light on the extent to which KappAbel is successful in this: Does it succeed in enrolling teachers and students in new mathematical practices through the provision of resources for those practices in the form of the competition and the tasks? And if that is the case, does enrolment in such practices – initiated by outsiders to the specific classroom – pave the way for changes in the way teachers and students conceive of mathematics and its teaching and learning?

The design of the study seeks to take into account the critical remarks made above about mainstream belief research. In the initial project description (Wedege, 2004), we questioned an assumed straight-forward relationship between teachers’ beliefs and the classroom practices. Inspired by Pehkonen and Törner (2004), we also pointed to the need to distinguish between teachers’ ideal and real teaching of mathematics in questionnaires and interviews. Finally, and referring to Wedege and Henningsen (2003) we pointed to a possible conflict between the teachers’ and students’ beliefs
and attitudes towards mathematics expressed in their own words and the researchers’ words expressed in a questionnaire. Later in the process of designing the study, we considered in particular three specific, interconnected methodological problems that may be seen as instances of the general criticisms mentioned in section 2.

First, there has been a tendency in belief research to build on Ernest’s (1989, 1991) distinction between three educationally relevant views of mathematics. Ernest claimed that the subject may be seen as (1) a set of unrelated facts and procedures, a toolkit that is useful for purposes external to the subject itself; (2) a Platonic and objectively existing body of knowledge to be discovered; and (3) a problem-driven and process oriented dynamic field, an ever-expanding human creation. Pehkonen and Törner (2004) is one example of a use of Ernest’s scheme. Phrasing the scheme as a toolbox view, a systems view and a process view of mathematics, they asked teachers to locate their real and ideal teaching practices on an equilateral triangle with the three views placed at the vertices.

Ernest’s trichotomy was made with reference to the apparent philosophical relevance of the three views and to what he terms their “occurrence in the teaching of mathematics” (1989, p. 250). Further, Ernest links the three views of mathematics immediately to corresponding views of the role of the teacher and the student in mathematics classrooms.

Notwithstanding the significance of Ernest’s scheme as a way of structuring the educational discourse on mathematics, it may be questioned whether the three views and the corresponding connections to teaching and learning are well grounded empirically. If this is not the case, it is a problem to the extent that the scheme determines the types of questions asked and the types of answers obtained in research. In other terms, it may be argued that Ernest’s scheme does necessarily capture significant aspects of the teachers’ school mathematical priorities, but impose the trichotomy (toolbox/system/process) on the teachers or students in question, if it is used as an analytical tool.

Second, it is not obvious how important the teachers’ views of mathematics are, even if the tripartite scheme does capture significant aspects of it. Even if the mathematical priorities of a teacher may be seen to be in line with one or a combination of the three views of mathematics mentioned, it does not imply that such a view is of particular significance neither to way the teacher views him- or herself as a teacher of mathematics, nor to the way he or she contributes to the interactions of the mathematics classroom. Consider, for instance, a teacher with a strongly child-centred view of education. It may be that she also considers mathematics to be associated with a certain combination of the three elements of the scheme and that she is therefore able to position herself in the equilateral triangle suggested by Pehkonen and Törner. In and by itself, however, this does not indicate how significant her mathematical priorities are for her contributions to the interactions in the classroom.
This problem relates to the well-known question of the centrality or peripheral character of beliefs. However, in contrast to most studies in mathematics education it contextualises this question by acknowledging that the objects and motives that dominate the teacher’s activity in a mathematics classroom may not be the same as the ones that frame her activity when being an object of study. In other terms, structuring a questionnaire, an interview protocol or an observation schedule along the lines of the Ernest scheme may reify the view of mathematics and attach a much greater significance to it than what is warranted if a more grounded approach to research on teachers’ and students’ educational priorities and activity is used.

Third, no terminology carries unequivocal meanings. This is so also for the rhetoric of the reform in mathematics education. More specifically, an emphasis on notions of problem solving and project work, or claims that school mathematics should be directed at working with the students’ real world problems do not necessarily mean the same for all. This is banal, but it challenges the use of fairly closed questionnaires or interview protocols as a means of accessing teachers’ or students’ school mathematical priorities. At the same time it may explain the prominence of the approach that Lester described (cf. section 2) of becoming involved in a circular argument: we do need more than espoused views of mathematics and its teaching and learning in order to warrant a claim about the existence of beliefs. From this perspective Lester’s point may be rephrased to say that although several approaches may be needed in the study of beliefs, these approaches do not necessarily shed light on the same object – a context-independent mental construct called beliefs. In spite of that, multiple methods have proved to be of relevance also to overcome the problem of the multiple meanings of the terminology used. For instance, classroom observations with follow-up interviews stimulated by recordings of interactions in the classroom in question have been used successfully. The strength of this combination, however, is not that it draws a more accurate picture of a stable and decontextualised construct of school-related mathematical beliefs. Rather, it is that it may situate teachers’ and students’ reflections about mathematics and its teaching and learning within the context of a relevant classroom and contribute to an understanding of how the teacher interprets the interaction in question from the perspectives that the teacher herself finds the most significant.

One further aspect of our methodological considerations - related to all the three problems discussed above – is related to Bourdieu’s notion of symbolic violence. In his last major research project, La misère du monde (“The Misery of the World”) Bourdieu and his team (2001) collected and analysed testimonies from hundreds of respondents about their lives. In a retrospective methodological chapter called Comprendre (“To understand”), Bourdieu presents the underlying epistemological assumptions of the diverse operations of the inquiry: selection of interviewers, transcription and analysis of the interviews, etc. The interview, he claims, is a social relation with effects on the results obtained. This is so although the research interview
differs from most ordinary dialogues in that it aims at pure cognition and by definition of scientific inquiry excludes the intention of using any form of symbolic violence that may influence the responses. However all kinds of distortions are inscribed in the mere relation of an inquiry, for instance in an interview.

It is, for instance, the interviewer who sets the rules of the game and who initiates it. This creates an asymmetry between interviewer and interviewee, the significance of which is doubled, if there is a hierarchical relationship between them in terms of cultural capital. In any piece of research, this inserts a power relationship – an element of symbolic violence – that necessarily influences the results.

4. A DISCUSSION OF THE DESIGN OF THE STUDY

The methodological challenges and difficulties mentioned above implied that we had to use different empirical approaches to the problem field. Dealing with Norwegian experiences, the KappAbel research project includes five types of empirical data – quantitative as well as qualitative. These are

- LS1: A questionnaire administered to the teachers of 2856 grade 9 mathematics classes in the 2004-2005 academic year.
- LS2: (a) A short questionnaire sent by email to 351 teachers whose classes took part in the two introductory rounds of KappAbel. (b) A questionnaire administered to 15 of these teachers whose classes intended to continue with the project work, whether their classes progressed to the semi-finals or not;
- Interviews conducted with six teachers and three groups of students at the national semi-finals; further interviews with two teachers and two groups of students are planned.
- The reports and process log books of five classes on the project work of Mathematics and the body. (Students from these five classes were among those interviewed or observed).
- Observations of 10-15 lessons in 3-4 classes all of which progressed to the national semi-finals or were one of the five best in the county (planned).

The intentions behind LS 1 are to get some understanding of who the participating teachers are, both with regard to their objective characteristics (education, teaching experience, sex, etc.) and to whether they consider themselves in line with the rhetoric of the current reform. The latter of these intentions is to contribute with knowledge about the extent to which KappAbel is confirmative rather than formative. The question, then, is whether the participating teachers consider themselves more in line with the overall intentions of the competition than their non-participating colleagues. Considering the methodological problems mentioned above, the aim is not to point to any substantial ‘objective’ correspondence between the KappAbel intentions and those of the participating teachers, let alone to imply that the teaching-learning practices of the participating students and teachers are more or less in line with current
reform initiatives than those of their peers. LS1 merely attempts to find if and how the terminology of the KappAbel project resonates with the priorities of the participating teachers to a greater extent than with those who do not participate. Furthermore, the statistical data from the large quantitative data set, LS1, will also be used to see the qualitative data from a limited and heterogeneous sample (LS2 and the interviews) in a proper perspective: to what extent are the participants in the qualitative study different from the population in general in terms of their objective characteristics. For this reason the factual information obtained in the two questionnaires (the teacher’s background and experience) is identical.

The second questionnaire, LS 2, was administered to the teachers whose classes took part in the project work on *Mathematics and the body* following the two introductory rounds of KappAbel. The items of LS2 are to some extent informed by a preliminary analysis of the responses to LS1. For example we used factor analysis in LS1 as a way of reducing the dimensionality of the problem (What should be the main focus of school mathematics?) and find latent structures in the data. These structures were created solely from the data. The following dimensions were constructed on the basis of a factor analysis with three factors: (1) Everyday mathematics and basic skills; (2) Investigations and new mathematical questions; (3) Logic and structure. The theoretical framework (toolbox/system/process) was not involved in the analysis at this stage. However, from the outset, our questions were constructed on the basis of these three theoretical categories.

In LS2, some of the items are closed, but the limited number of respondents allowed us also to use more open and qualitative response items. Some of these are fairly traditional, and for instance ask the respondent to reflect on good and bad experiences with teaching mathematics. Other items require the respondent to comment on statements made by (imaginary) colleagues about key aspects of KappAbel (collaboration, project work, gender). One example reflecting a teacher’s view of boys’ and girls’ work in the mathematics classroom reads like this:

“Boys and girls have different kinds of strengths and weaknesses in mathematics, which they should be allowed to go for. That’s why boys should work together with boys and girls with girls.”

The intentions behind this dual format of the open items may seem self-contradictory. On the one hand they aim to allow the respondent to focus on what he or she sees as the most significant aspects of mathematics teaching and learning. This is opposed to a situation in which they are exclusively to respond to items framed for instance by the scheme (toolbox/system/process). On the other hand, the other set of items invite the teacher to respond to a set of very specific statements from ‘their colleagues’. These may provoke a concrete response, but are meant to contextualise the teacher’s reaction by involving him or her in a virtual dialogue that allows any response whatsoever. In spite of the concrete wording of these items, then, they intend to allow the
teacher not only to signal for instance degree of agreement or disagreement, but to reject the agenda inherent in item altogether.

Semi-structured interviews were conducted with both teachers and students during the national semi-finals. The intention was on the one hand to let the teachers and students talk freely about what they conceive as significant and valuable teaching/learning experiences without initially framing their answer within a pre-conceived scheme. On the other we wanted to get an impression of how they perceived KappAbel and their own participation in it in relation to their everyday teaching. This may be seen as an attempt to strike a typical balance in semi-structured approaches to research between too tight and too loose a structure. For our purposes, and to minimize the symbolic violence in the interviews, we have tended to move towards the lose end of the continuum. The Norwegian research assistant, who is also a mathematics teacher, conducts the interviews, which may help in reducing the significance of a hierarchical relationship between researches and teachers.

Observations of 10-15 lessons in 3-4 classes are planned. We intend using the interpretations of the individual teacher’s response to LS2 and to the questionnaire as well as the students’ comments in the interviews as an interpretive device in relation to practice. This is not an attempt to make ‘consistency’ or ‘inconsistency’ descriptions of the teachers in question, but in some sense to triangulate our previous understandings (based on interviews and questionnaires) of what they prioritise in mathematics education and to get some indication of how prominently these priorities play in practice under the institutional constraints of classroom teaching. However, we do not consider this a case of traditional methodological triangulation. The problem is that methodological triangulation is normally considered an attempt to adopt a variety of different perspectives on the object under study. This is part of what we wish to achieve. However, some of the substantive criticism raised above of the lack of social orientation of mainstream belief research exactly questions the extent to which it is indeed the same object that is being studied in for instance a research interview and in classroom observations. It may be that teacher’s beliefs play a part for the classroom interactions, but the call for a more social approach in belief research is exactly built on the understanding that the teaching-learning practices unfolding in the mathematics classroom are not the teacher’s practices in the possessive sense of that term. However, having teachers comment on specific interactions in follow-up interviews may provide increased insight into their school mathematical priorities, including what their potential role is in relation to unfolding classroom practices.

5. CONCLUSIONS

Research on beliefs and attitudes is a difficult field, methodologically speaking. On the one hand, one needs a variety of different approaches to capture significant aspects of teachers’ and students’ beliefs and attitudes towards mathematics. On the other one should not expect different methods to shed light on the same object of be-
liefs, and consequently the idea of triangulation takes on a different meaning than one of locating a single point or object in a space of two or more dimensions by using a variety of such methods.

These methodological difficulties lead to some rather more conceptual ones: Does the constructs of belief and attitudes point to an object that is as stable and decontextualised as one is sometimes led to believe(!)? More specifically, are the claimed manifestations of teachers’ and students’ mathematical beliefs sufficiently grounded empirically to claim that they are part of the way in which the person in question conceives the world and him or herself within it? Does the significance attached to students’ and teachers’ beliefs about mathematics resemble their own priorities, for instance in comparison with their general view of children, of school, of education and of mathematics in schools - or does that significance to a greater extent impose a mathematical perspective on the teachers and students, a perspective that may be much less important to them than to the researcher?

These questions may be summed up as one of the extent to which the researcher’s imposition of the construct of beliefs on the students and teachers in question is an exertion of symbolic violence in the sense of Bourdieu. And this feeds back into the methodological considerations: Is there any way of reducing the significance of that violence by exerting it differently?

In the KappAbel study we use a well-known methodological cocktail of large scale questionnaires, interviews, observations and analyses of students’ work. Within the timeframe of the present study we have only managed to a very limited extent to come up suggestions for methods that break with or supplement the ones that are used in most other studies in the field. One may then rightly ask if and to what extent we fall prey to the same types of criticism that we raised against other studies in the field.

To some extent this is undoubtedly so. However, our answer to that question has two more elements. First, we do use well-known methodological tools, but we do so in ways that are not quite so well-known. For instance in LS 2, we seek to establish a context for teacher reflection by simulating an interaction between the respondent and a fellow-teacher. This intends to limit the extent to which the teacher conceives of the situation as a confrontation with an agenda imposed on him or her by the researcher. The intention is, then, to initiate a type of virtual dialogue, by inviting the teacher to react to a statement made by a ‘colleague’. We have also reasons to believe that the technical dimension of the methodological construction is important when it comes to evaluating the findings. As a consequence, the interviewer is a research assistant who is a mathematics teacher herself: young Norwegian mathematics teacher interviews young Norwegian mathematics teachers. This reduces the asymmetry inherent in the social relation of the dialogue. This was not the case with the students who obviously felt ill at ease in the situation. As an experiment we plan to invite one of the students
who participated at the KappAbel semi-final to interview the rest of her group, although - as pointed to by Bourdieu – a social and cultural resemblance between interviewer-interviewee may create other problems.

Second, and more importantly, we try to make the sense of the data collected with those tools in ways that acknowledge the significance of the types of criticisms listed. This last element, then, has more to do with the analyses and interpretations of the data than with the character of the data-collecting tools themselves. For example, a teacher’s response to the first questionnaire is not interpreted as an indication of ‘real’ compatibility between his or her thinking about school mathematics and the intentions of KappAbel. Rather it is seen merely as an indication of the teacher’s possible compliance with the rhetoric of the reform, and therefore as an indication of the extent to which participants in KappAbel consider themselves in line with the dominant reform discourse. Also, the interpretations do acknowledge that the results are not grounded in an empirical study and that whatever answer we obtain in terms of teachers’ priorities of school mathematics should be interpreted with this in mind: we have not managed to set up a design that build on the teachers’ own thinking. What we may be able to do is to shed some light on how the teachers, given the alternatives inherent in the Ernest scheme, prioritise aspects of mathematics. In relation to the aims of the study, we can claim that if it is fair to suggest that the priorities of the KappAbel competition include a vision of mathematics as at least encompassing the process perspective, the study may shed some light on the extent to which teachers at the level of rhetoric orient themselves in the same direction, when faced with a limited range of alternatives.

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