Quality criteria in mathematics education research

The nature and status of mathematics education as a research discipline has been a subject of reflection in the international research community during the latest three decades. As time passes and research activity in the area proliferates, a meta-reflection on the discipline or the research area becomes more central. One of those meta-reflections concerns what is taken as quality of research and its results. Already in 1994 the ICMI study *What is research in mathematics education and what are its results?* (Sierpinska & Kilpatrick, 1998), a subgroup within the study had as a task to discuss what criteria should be used to evaluate the results of research in mathematics education. Starting from the idea that, as a scientific field becomes a discipline, there is a need of reaching agreements about what counts as quality in research, the group concluded that it is not possible to present one unified set of criteria of quality, but that it was important to take into account the "considerations that inform judgements about the quality of research in mathematics education" (p. 29). Therefore, the group proposed exploring how the different elements that constitute mathematics education as a field could generate different sets of criteria. For example, is it possible to generate criteria for quality of research when considering the relationship between research and educational practice? Or its relationship to mathematics? Or to other foundational disciplines? (p. 30–31). Each one of these sets of relationship will lead to considering different definitions of quality.

More recently, the issue was addressed at the ICMI-2008 symposium in Rome celebrating the centennial of the foundation of ICMI. In the proceedings from the symposium, subtitled *Reflecting and reshaping the world of mathematics education* (Menghini et al., 2008), there is a chapter by Jeremy Kilpatrick, with the title *The development of mathematics education as an academic field*. Here the scientific status of mathematics education research is discussed and it is questioned to what extent the research in the field has developed scientific theories. From the reaction to the lecture given by Jean Luc Dorier and from the debate that followed, it was clear that there where different opinions on how to judge the nature and scientific status of different research trends, of the results achieved and of the theories developed in the field. Such differences may

be explained by differences in research traditions that have developed differently in various research milieus and countries. This type of discussion could suggest the idea that even though in a community there is a need for having criteria of quality, it may be almost impossible to think that there can be one and only one set of criteria that would be equally applicable and relevant to all research carried out in the field. In fact, many authors argue for the need of reconstructing classic research criteria such as validity, reliability and generality in relation to the emergence of new research methodologies and new research problems (e.g., Lesh et al., 2000; Vithal & Valero, 2003).

In the Nordic region mathematics education research as an academic field has been undergoing a rapid development during the last two decays. In 1992, at the time that the symposium with the title *Criteria for quality and relevance in mathematics education* (Nissen & Blomhøj, 1993) was held, there were only few professors and less than 10 Ph.D. students in the whole Nordic region. This symposium was one of the importing starting points for the Nordic collaboration in the field. The plans of the publishing NOMAD were finalised at a meeting during the symposium, and the first issue of the journal was published the year after. Internationally prominent researchers – among them Jeremy Kilpatrick – gave presentations and commenting on ongoing Nordic research projects. Since that time, the discussion of criteria of quality has occupied an important space in the conversations among researchers. The need for a broader and updated discussion on this issue is even more actual now than ever since we are experiencing a boost in the growth of the community. Nowadays, we have a Nordic Graduate School in Mathematics Education, several national doctoral programs and growing research milieus with professorships in many places in the Nordic region. However, mathematics education is still in the process of establishing itself as an academic discipline institutionally. Reflecting on the characteristics and the scientific status of research and research results in mathematics education is of extreme importance in relation to the interdisciplinary relationship with supporting sciences such as mathematics, pedagogy, psychology and sociology. What is specific for the forms of research that mathematics educators develop, and why are results relevant or even necessary? Moreover, we need to keep the meta-reflection on our discipline alive as a basis for prioritising the research effort and resources between different possible research programmes.

For these reasons we have decided to make *Quality criteria in mathematic education research* the topic for the next thematic issue of NOMAD. The theme can be addressed from many different perspectives: normatively, philosophically, historically, by meta-analysis of research papers or

through case studies, and all such approaches are of interest. Of course, we prefer contributions with a distinct Nordic perspective. Papers for the thematic issue should be submitted no later than August 15, 2009.

In this issue

Two of the three papers presented in this issue are researching student teachers' beliefs and didactical reflections concerning the teaching and learning of mathematics. In both cases the underlying purpose is to provide scientific knowledge for raising the quality of teacher education in mathematics. The third paper reports on a theoretical and empirical investigation of how to operationalize the concept of contextualisation in a teaching experiment challenging and supporting the students' probabilistic reasoning.

The paper by Lisen Häggblom *Lärarstuderandes syn på lärande i matematik* reports a phenomenological study on prospective teachers' attitudes and beliefs in relation to the learning of mathematics. The study includes 77 Finnish prospective teachers, and their attitudes and beliefs are uncovered by means of qualitative text analysis of essays produced on the encouragement: *Describe your view of students' learning in mathematics and your role as a mathematics teacher.* In the first part of the paper the author presents an overview of part of the research literature on student teachers' and teachers' beliefs and reflections on the learning of mathematics. The analysis of the essays identifies respectively four and six general positions concerning the students' beliefs about pupils' learning of mathematics and about their own role as a mathematics teacher. Beliefs about the importance of pupils' motivation for learning mathematics and its connection to affective factors and the important role of pupils' activity and communication in the learning process are among the most dominant. On the other hand, addressing diversity among pupils, showing the relevance of mathematics in connection to the daily life of the pupils, and organising the learning environment for activity and communication are some of the student teachers' beliefs concerning their role as mathematics teachers. In addition, the analysis shows that the students express clear general positions about mathematics as a school subject, and that these positions are connected to their general beliefs about the learning and teaching of mathematics. In general, the analysis documents that the students have a holistic perspective on the learning and teaching of mathematics, and hence the research supports that didactical reflections from a holistic point of view is given appropriate attention in teacher education programmes.

In the paper *Dialogical inquiry in practice teaching*, Marit Johnsen-Høines reports from a developmental project in which researchers/teacher educators, student teachers and tutor teachers collaborated in subject-oriented conversations within the framework of teaching practice. The paper is written in a way that invites the reader to have a sense of how the process of collaboration between these three groups of people developed along the project. Starting from the mismatch between teaching practice being recognised as a central element in teacher education and teaching practice not being perceived by teacher students as an opportunity to connect theory with practice, the teacher educators – who also were the researchers – invited tutor teachers and student teachers to engage in a process of improving the types of conversations that they hold in the evaluative meetings connected to teaching practice. The openness of the invitation made by the teacher educators contributed in the creation of a sense of ownership to all participants in the project. The main aim of developing subject-oriented conversations, that is, conversations around mathematical and mathematics education issues emerging in the context of teaching practice, became a common goal. The subject-oriented conversations also permitted to alter the characteristics of the conversations that normally take place in teaching practice, making the new space of conversation a richer space for the professional qualification of student teachers.

The third paper by Per Nilsson O*perationalizing the analytical construct of contextualization* aims at developing and testing a set of analytic tools for organizing our thinking about teaching and learning mathematics. The theoretical frame concerns the process to assimilate new elements of knowledge into a conceptual network and it relates explicitly to constructivism. The theory includes thus the process to contextualize experiences by doing investigations. The theoretical issues are investigated in the paper by means of analysing the students activity in a very carefully designed teaching experiment which challenge and support lower secondary pupils' probabilistic reasoning. In the experiment eight students are engaged with a structured series of tasks with two dices, designed as a set of games. The overall purpose has been to challenge the students to base their probability reasoning on the structure of the sample space. For example, with rolling two dices marked (222244) and (333355), the students are challenged to reason on the outcome space for the sum, namely [5, 7, 9] and in the next turn to recognise the different probability of the outcomes. The author analyses the mathematical activities involved in a contextualization process using four sets of categories, identified from the literature as crucial in contextualization. These four categories, which are (1) the context and mathematical potential

of the problems, (2) issues of familiarity, (3) context variation and (4) reflection on validity, explain very well the difficulties that the students experienced in the experiment.

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