

Working Group 9 for Teacher Education and Development

Position paper from Marjorie Henningsen

For over a decade throughout the world mathematics educators and researchers have advocated for important changes in curricula and pedagogy for school mathematics. Catalyzed by large scale international studies of student achievement in mathematics (e.g., SIMSS, TIMSS), education policy makers around the world continue to call for reform of mathematics education at the elementary, middle, and secondary school levels. One aspect of these calls for reform is an increased emphasis on high level thinking, reasoning, and communication in mathematics classrooms in order to increase students' abilities to solve problems, think and reason in flexible, critical, and creative ways, and to gain conceptual, meaningful understanding of the mathematics they are learning. Indeed, it is hoped that students will also gain a more textured understanding of the nature of mathematics and mathematical activity.

Recent research has shown that students who are more often engaged in mathematical tasks that require high level thinking, reasoning, and communication perform better than students who spend the majority of time engaged with tasks requiring only low-level cognitive demands such as memorization and recall of facts, or mechanical practice of routine mathematical procedures. Also, the kinds of mathematical tasks and classroom environments needed to support student engagement in high level thinking and reasoning require a drastic change from the traditional roles of teachers, students, and tasks in the mathematics classroom. Moreover, research has also shown that good curricular tasks are not enough; what is learned often hinges on the interactions among teachers and students and the intellectual environment in which these interactions take place. Although the calls for reform often clearly specify *what* needs to be done to improve mathematics teaching and learning in schools, more work is needed to understand *how* teachers should go about implementing reform ideas into their daily instruction. Hence, the education and development of teachers who will have the capacity to engage their students in high level thinking, reasoning, and communication in mathematics is of paramount importance.

Mathematics Teaching and Teacher Development

Mathematics teaching is a multi-faceted, complex problem solving activity. Success requires the ability to collect, interpret, organize, and select useful information and the ability to think independently, flexibly, creatively, and logically about the subject matter, about how to teach it, and about how students think about it. There are a variety of points of view about what constitutes good mathematics teaching and there are many important goals for the development of good teachers. These goals include:

- a) developing knowledge, skills and dispositions about mathematics that will allow for critical reflection on one's own mathematics teaching;
- b) developing a personal model of how mathematics is learned that continues to grow, to be elaborated, and to be modified as new experiences and information are integrated;
- c) deepening understanding of how children learn mathematics, how children's mathematics differs from the teacher's mathematics, and how a teacher can facilitate the mathematical growth and development of **all** children;
- d) expanding mathematical understanding, enriching views regarding the nature of mathematics and mathematical activity, and develop teaching strategies that can facilitate children's mathematical thinking and understanding - listening to children, observing their activities, communicating with them, interpreting their mathematical thinking, selecting and generating rich learning tasks that use multiple tools, including technology, to foster their conceptual growth;
- e) developing methods of assessing student learning in mathematics that provide a multi-faceted portrait of what students understand and can do, and what they do not, and of using

this assessment to guide the creation of environment conducive to the children's learning of mathematics; and

- f) recognizing and appreciating the value of collaboration through interactions with colleagues and viewing oneself as part of a larger community of mathematics education professionals who are involved in creating learning environments for children that emphasize thinking, reasoning, problem solving and the communication of mathematical ideas.

The above goals may be pursued throughout a professional career, beginning with pre-service or practice teaching at the undergraduate or graduate levels in university with continued growth and reflection over years of professional classroom service. These goals for teacher development also have implications for the work of teacher educators and professional developers in their efforts to provide pre-service, beginning and experienced teachers with appropriate levels of support and appropriate development experiences according to the specific needs of individuals and groups of teachers with whom they are working and, as much as possible, grounded in teachers' own practice.