

## **Seminar „Making Lifelong Learning a reality“**

**Cologne, 7<sup>th</sup> to 9<sup>th</sup> March 2004**

Intelligent Knowledge as a Learning Objective

Elsbeth Stern

Max Planck Institute for Human Development

In research on learning and development, the importance of domain-specific knowledge for cognitive growth is now widely recognized. Children's particular difficulties with formal tasks seem to be due to their limited access to learning opportunities – the child can be seen as an universal novice – rather than to more general constraints on cognitive functioning. Research on expertise, too, emphasizes the crucial role of prior domain-specific knowledge – many years of deliberate practice are necessary to achieve excellence in complex content areas. These results suggest that to learn science and mathematics at school students should, from the very beginning of their school career, be afforded the opportunity to acquire the domain-specific knowledge which lays the foundation for advanced competencies in these areas. My own longitudinal data on science and mathematics learning show that elementary school students who show advanced domain-specific conceptual knowledge enjoy a long-term head start. Research on learning and instruction has to meet the challenge of explaining how early conceptual knowledge is restructured to provide an elaborated and flexible understanding as a function of instructional input. I will discuss this issue by referring to cognitive theories of analogical thinking, symbolic reasoning, conceptual change, and constructivist learning. Moreover, I will present results from experimental training studies exploring how to stimulate elementary school students' scientific and mathematical reasoning.