

Abstract

Mathematics instruction, rather than solely rely on step-by-step teacher-centered learning of mathematical routines (which, as such, would reflect a more receptive view of learning and instruction), should stimulate students' in-depth understanding of mathematical content (De Corte, 2004), in line with a constructivist view of learning and instruction that focuses on its interactive, constructivist, and cumulative nature. While research in learning and instruction seems to have reached a consensus in this respect, the extent to which a constructivist view of learning and instruction has been received by teachers and is reflected in their professional knowledge and classroom action is still an open question. Teachers' action competences are assumed to be closely linked to their knowledge (Philip, 2007; Baumert & Kunter, 2006). The structure and content of the professional knowledge base is conceptualized referring to a broad view of teacher knowledge as a compound of declarative and procedural, implicit and subjective knowledge that is practical as well as reflexive, with all of its elements being variously inter-related. The present study focuses on pedagogical content knowledge where no separation is possible between *how* a domain-specific content is taught and *what* this content is. With respect to the action relevance of professional knowledge, the study distinguishes between general beliefs that are less effective in terms of immediate classroom action, and highly action-relevant situational beliefs that are primarily effective in complex situations requiring rapid action choice (Wahl 1991). An examination, in a philosophical and psychological perspective, of the extent to which knowing-how can become a conscious skill reflects the importance of including implicit, hard-to-verbalize professional knowledge in the analysis of classroom action and illustrates the challenges bound up with the use of sophisticated methods for assessing professional knowledge.

The aim of the present study was to investigate the quality of instruction by relying on a multi-perspective approach. To this end, two constructs of teacher cognition (general beliefs with low action potential, on the one hand, and situational beliefs, on the other hand) were assessed and, ultimately, related to the videobased assessed cognitive demands of task processing as well as to students' self-reports, as elicited by questionnaire, and students' achievement. The study was part of the project "Unterrichtsqualität, Lernverhalten und mathematisches Verständnis" (Quality of instruction, learning behavior, and understanding of mathematics), a cooperative effort of the Deutsches Institut für Internationale Pädagogische Forschung (DIPF, German Institute for International Educational Research) and the Pädagogisches Institut (Institute of Education) of the University of Zurich. 20 classrooms in secondary school in each of both countries participated in the study. Three lessons dedicated to an introduction to the Pythagorean theorem were chosen as an empirical framework for the present non-representative study. Teachers were asked to fill in a questionnaire targeting, among other issues, their general pedagogical content beliefs (Rakoczy, Buff & Lipowsky, 2006). Each

videotaped lesson was immediately followed by an assessment of relevant situational pedagogical content beliefs using a guided interview in terms of retrospective think-aloud protocols (Ericsson & Simon, 1980) that was specifically elaborated for this purpose. High-inference codes were employed to analyze the videotaped lessons in view of the cognitive demands of task performance (Drollinger-Vetter & Lipowsky, 2006). Further indicators of instructional quality were students' self-reports, as stated in the questionnaires, on learning gains and understanding as well as emotions after the three lessons (Rakoczy et al., 2005), and test-based assessments of students' performance before and after the three introductory lessons (Lipowsky, Drollinger-Vetter, Hartig, & Klieme, 2006).

The multi-method approach implies a combination of qualitative and quantitative analyses. Frequencies and variance analyses were used to categorize teachers' professional knowledge and to highlight specific features of each of the two countries. Case studies served to document extreme cases. Correlations were used to reveal the links between general and situational pedagogical content beliefs, as assessed immediately after the lessons, as well as video-based evaluations of the cognitive demands of task performance. Multi-level analyses provided an insight into the effects of professional knowledge on the outcomes of instruction as evaluated by the students.

Teachers' general beliefs in both countries showed a high degree of constructivist orientations. However, approval for a constructivist view of learning and instruction was stronger, while approval for a receptive view of learning and instruction was weaker, in German than in Swiss teachers. On the other hand, analyses of videotaped lessons revealed that Swiss teachers were significantly more inclined to stimulate associative mathematical reasoning. Some systematic links could be shown to exist between situational beliefs that were compatible with a constructivist orientation (assessed by teacher interview), on the one hand, and general constructivist beliefs (assessed by teacher questionnaire), on the other hand, as well as the cognitive demands of task processing (assessed by external rating). In the case studies, a comparison of situational beliefs on the level of paraphrases and narrations of classroom action showed that teachers themselves tended to account for situations on an individual level and that same-type situational beliefs were not necessarily bound up with same-type narrated actions. An examination of the effects of professional knowledge on students' perceptions and achievement showed that situational beliefs that can be attributed to a constructivist view of learning and instruction are an adequate indicator for the occurrence of classroom action reflecting these cognitions which, in turn, is reflected in students' evaluations. Furthermore, situational beliefs that can be attributed to a receptive view of learning and instruction could be shown to have a negative effect on student achievement.

The present study helped to identify two major issues for pedagogical practice: First, including teachers' professional knowledge is a key requirement for a comprehensive evaluation of the quality of instruction. On the other hand, the psychological structure of professional knowledge has certain implications for the

knowledge to be transferred in teacher education, pointing to the need for the latter to stimulate reflexive learning in theory and in practice in order to link up the practical and the theoretical elements.