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Teaching for understanding and/or self-regulated learning? A video-based analysis of reform-oriented mathematics instruction in Switzerland

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Abstract

In mathematics instruction, can a teacher implement surface features of instruction that foster self-regulated learning as well as achieve quality at the deeper level of instruction, that is, focus on higher-order thinking, problem-solving, and mathematical modeling? An educational reform effort in Switzerland, which is based on constructivist and sociocultural theories of mathematics learning, targets both these dimensions: self-regulated learning and conceptual understanding. We examined the realization of the two dimensions in classroom instruction in a video-based study of 79 eighth-grade math classes using three kinds of data: videotapes of mathematics lessons, student and teacher questionnaires, and achievement tests. As to the surface level of instruction, teachers reported how frequently they provided opportunities for self-regulated learning. With regard to the deeper level of instruction, teachers reported how frequently they provided opportunities for independent problem solving. In addition, we examined the extent to which teachers' pedagogical beliefs reflected a constructivist orientation. The results showed that teachers implemented the two dimensions relatively independently of one another. Teachers' constructivist-oriented beliefs influenced only opportunities provided for independent problem solving and did not affect opportunities for self-regulated learning. Opportunities for self-regulated learning had a positive effect on students' learning experience. Professional development should encourage teachers to take greater account of both surface-level and deeper-level (quality) features of instruction.

Keywords: Mathematics instruction; Self-regulated learning; Instructional quality

1. Introduction

Mathematics instruction in Switzerland is influenced by two instructional models. For one, educational reform notions of student-oriented instruction (partly inspired by the German tradition of progressive education) have long played a relatively important role. As compared to traditional instruction, student-oriented instruction seeks in the main to grant students greater autonomy in learning by using more open forms of instruction, such as individualized learning assignments for the week or project work. Characteristic

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of this reform effort is a focus on surface-level characteristics of instruction rather than on the deeper level of the quality of students' learning processes. The second model arose in the 1960s, when Swiss mathematics instruction came to be strongly influenced by the cognitive–constructivist-based didactics of Aebli (1963). Based on Piaget's psychology of thinking, Aebli strongly emphasizes the instructional goals of conceptual understanding and problem orientation. Here, there is a much stronger focus on the quality of learning processes, or the deeper level of instruction. Beginning in the 1990s, a reform initiative in Switzerland called "Extended Forms of Teaching and Learning", taking both models of instruction into consideration, has sought to synthesize the two dimensions.

Is this reform initiative being implemented in the everyday practice of mathematics instruction in Switzerland? Surveys of teachers show that some teachers describe their own instruction as reform-oriented (Pauli & Reusser, 2003; Pauli, Reusser, Waldis, & Grob, 2003; Stebler & Reusser, 1999). In addition, teachers tend to agree with a constructivist understanding of teaching and learning processes (Lipowsky, Thussbas, Klieme, Reusser, & Pauli, 2003). But it remains to be clarified whether the teachers in fact apply their understanding of learning and components of the reform concept in their teaching practice in mathematics instruction.

There are some indications in the results of the TIMSS (Third International Mathematics and Science Study) 1999 Video Study (Hiebert et al., 2003), which investigated mathematics teaching in seven countries. As in other comparative studies (for example, Alexander, 2006; Clarke, Keitel, & Shimizu, 2006), the TIMSS study tried to construct descriptions of the teaching practice in the individual countries based on certain features and characteristics. These analyses, which aimed at identifying "national patterns of teaching", show that mathematics instruction varies more within Switzerland than within the other countries investigated (Givvin, Hiebert, Jacobs, Hollingsworth, & Gallimore, 2005). This could be interpreted as an indication of the co-existence of a reform-oriented and a traditional classroom culture within mathematics teaching in Switzerland. Further analyses of the sample from German-speaking Switzerland showed that different types of mathematics lessons can be distinguished according to the choreography of teaching and learning activities, whereby on the surface level of the organization of instruction, both teacher-guided and student-centered instruction were observed (Hugener & Krammer, 2001). But the question of the extent to which Swiss teachers fulfil the two demands of the reform model—namely, to simultaneously enable self-regulated learning *and* problem-solving and higher-order thinking—remains unanswered. Empirical investigations in connection with teaching reforms show that reform concepts are often not implemented as intended (see, for example, Brodie, Lelliott, & Davis, 2002; Richardson & Placier, 2001; Saxe, Gearhart, Franke, Howard, & Crockett, 1999), even if the teachers are a part of systematic in-service programs.

Upon this background, the present study focuses on the implementation of current reform initiatives in everyday mathematics teaching practice on the basis of a sample of 79 Swiss mathematics lessons. Of particular interest is the extent to which individualized, more open forms of instruction, which are reforms primarily at the surface level of lesson organization, are compatible with quality-oriented instruction that aims at fostering conceptual understanding and problem-solving processes.

The present investigation was conducted within the framework of the Swiss Video Study (see Reusser & Pauli, 2003), which is both a part and an extension of the TIMSS 1999 Video Study (Hiebert et al., 2003). The Swiss Video Study was designed based on a systemic framework of quality of instruction (Fend, 1998; Helmke, 2003; Reusser & Pauli, 2003). This framework takes into account conditions of instruction, such as teacher and student characteristics, and sees educational effects as mediated by students' cognitive and motivational processes as well as by their subjective experience. The Swiss study therefore supplemented the TIMSS Video Study with further video analyses and data that allow teachers' instruction-related beliefs and self-perceptions as well as students' experience to be considered in the analyses.

2. Theoretical framework: teaching reforms in (Swiss) mathematics instruction

Since the 1960s, Swiss teaching has been strongly influenced by Hans Aebli, who was a pupil of Piaget. Aebli's influential work on "twelve basic forms of teaching" (Aebli, 1983), first published in 1961, has appeared in 22 editions so far. In that work, Aebli developed his didactics based on a constructivist understanding of teaching and learning processes. Like Piaget, Aebli assumed that learners "actively construct