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Title of your paper: Reconstructing action patterns of mathematics teachers in dealing with student errors

Abstract (300 words)

Student errors accompany every mathematics lesson and can, for example, help to uncover misconceptions and clarify problems of understanding. Teachers, however, sometimes perceive them as disturbing. This presentation will illustrate how 15 mathematics teachers in Hamburg react to student errors in their lessons and how they deal with them. Based on videos of the mathematics lessons, patterns of teachers' different strategies were identified.

Extended summary (1000 words, excluding reference list) introduction, theoretical background, methods, preliminary findings/findings, results, reference list.

Introduction

Empirical studies in mathematics didactics and teaching research consistently point to the interrelationship between teachers' professional competence, the instructional quality and the cognitive performance and motivation of their pupils (Baumert et al., 2010; Helmke, 2012). A positive way of dealing with student mistakes is a part of instructional quality (Clausen et al., 2003; Rakoczy & Pauli, 2006). However, a direct influence of teachers' professional knowledge on the quality of their mathematics teaching cannot always be shown, or the correlations found are often not as strong as hoped for (Baumert et al., 2010; Kersting et al., 2012). In recent years, the complementary use of different research methods within the framework of the mixed-method approach has proven to be a viable way of dealing with such questions (e.g. Kelle & Buchholtz, 2015). Taking up this approach, this research project deals with the reconstruction of teachers' action patterns in dealing with student errors, based on a sample of mathematics teachers who also participated in a test regarding their professional competencies.

Theoretical background

Following the approach of Blömeke et al (2015), the teachers' professional competencies can be understood as a continuum. It is conceptualized as a construct of cognitive and affective-motivational facets, whereby the description of the cognitive facets - the professional knowledge - goes back to Shulman (1987). He described an interaction of content knowledge (CK), pedagogical content knowledge (PCK) and general pedagogical knowledge (GPK). Based on this distinction well-known in mathematics didactics, Buchholtz et al. (2014) divide mathematical pedagogical content knowledge (MPCK) into a teaching-related and a subject-related component. The former comprises the more educational-psychological component and thus considers cognitions that relate to specific teaching-learning arrangements in mathematics instruction, curricula and concepts of mathematical education. Subject-related MPCK includes the subject-oriented diagnostics of students' solutions paths and other content-related aspects of teaching, such as the subject-oriented analysis of errors. Errors are part of learning and thus of teaching (e.g. Schoy-Lutz, 2005). They can advance the teaching, can help to uncover faulty ideas and clarify problems of understanding. Teachers, however, sometimes perceive them as disturbing (e.g. Oser et al., 1999). As a distinction, Oser and Spychiger (2005), for instance, mention "error avoidance didactics" and "error encouragement didactics", which they associate with different phases of teaching.

Study's Design and Method

The present study, which was conducted as part of TEDS-Instruct and TEDS-Validate, is one of the follow-up studies of the international IEA Teacher Education and Development Study in Mathematics (TEDS-M) (Kaiser et al., 2017). In TEDS-Instruct different knowledge facets (i. a. MCK, MPCK and GPK) of 118 in-service Hamburg mathematics teachers of the lower secondary level was tested. A sub-sample of 37 teachers was also surveyed using a newly developed instrument for classroom observations (Schlesinger et al., 2018) to determine their instructional quality in live ratings. Moreover, 15 of these teachers were again visited for two lessons (two times 90 minutes), and in addition to the rerun live rating, their mathematics lessons were filmed. These 30 videos allow a detailed look at individual items of the observation tool in the aftermath of the quantitative assessment of the instructional quality. The aim is to use a qualitative content analysis (Mayring, 2014) to gain insights into how the indicators for high instructional quality are implemented in practice. In a first step, the focus was on how teachers deal with student errors. To this end, all scenes in which student errors occurred were identified and then inductively coded. With the help of the MAXQDA program, the coding was performed directly on the video. The resulting data basis comprises 566 situations in which student errors could be observed.

Results and next steps

In the course of the evaluation, 44 codes could be generated which describe how the teacher deals with student errors.

For example, it was observed that almost all teachers, although with varying frequency, explained the incorrect way of thinking behind the errors to the student. Also, the coding of passing on the original question to other learners after an incorrect student answer could be applied to all teachers with one exception.

However, it can be assumed that several codes are more person-specific since some teachers tend to deal with errors in a certain way. For example, there are 14 error situations in which the teacher complains about the student error. However, this behavior can only be observed with a total of four teachers, with one teacher standing out with ten corresponding codes. Another teacher often refutes the incorrect student statements by giving a counterexample. The elaboration of such patterns shall be completed in the future. In this context, a variation regarding different teaching phases is to be expected. Thus, it will also be important to examine how errors are dealt with depending on the teaching phase. For instance, Oser and Spychiger (2005) as well as Schoy-Lutz (2005) have already provided indications of this, making a distinction between student-centered and teacher-centered respectively formal and informal phases.

Furthermore, the question of whether the codes always occur in a certain order is examined. The first results suggest that the observed teachers go through a phase-based structure after a student error. The phases vary widely depending on the teacher, which reflects the individual nature of the teacher.

These first outlined results already reveal extensive possibilities for analysis and underline the need to investigate how mathematics teachers deal with errors by further evaluating this study. As a further goal, the description of the indicators used in the observation tool (Schlesinger et al., 2018) will be followed up. This should, for example, answer the questions to what extent and in what way teachers use student errors as learning opportunities or which circumstances must be present for teachers to initiate a correction of the errors by the students themselves or by their classmates.

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