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Pre-service teachers' use of information when diagnosing first graders' number sense in text-image vignettes

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Introduction

A central goal of mathematics education in primary school is to develop flexible calculating and solid arithmetic competencies. These competencies require a comprehensive understanding of numbers and operations (number sense), which should be established during the early school years (Rathgeb-Schnierer & Rechtsteiner, 2018). In this context, teachers face every day the challenging task of comprehending their students' ways of thinking in order to provide them with appropriate learning opportunities. An essential condition for succeeding in this task is the teachers' diagnostic competence: When mathematics teachers want to find out what number sense a child has, they use information about the student's behaviour when solving arithmetic tasks to draw conclusions about his or her thinking and knowledge in this area. The quality of corresponding diagnostic judgements appears to depend on whether information valid for the diagnosis can be identified and used for this purpose. There is evidence that novices have limited ability to select valid information when diagnosing complex situations and also use invalid information, often resulting in lower quality of their judgements (Kellman & Massey, 2013). However, it is still unclear how and what information is used by pre-service teachers when diagnosing first graders' number sense, and whether the quality of their diagnostic judgments can be attributed to their use of information.

Theoretical background

In order to investigate how teachers form diagnostic judgments, a line of research has developed that focuses on the cognitive processes of information use that underlie diagnostic teacher judgments. Studies of this type examine cognitive processes, which are situational skills that mediate between a teacher's dispositions and actions (Loibl et al., 2020): Teachers, in order to accomplish a professional, complex task such as diagnosing learning processes, must (1) perceive information, (2) interpret it and (3) make decisions. Additionally, the influence of information use on judgment quality is illustrated in Brunswik's lens model (Brunswik, 1956): The better a person is able to select and use information with high validity, the higher the judgment quality will be. Although findings suggest that pre-service teachers are less likely to focus on children's learning and thinking processes when assessing their mathematical concepts, there is still little evidence on how pre-service teachers use information of different validity when diagnosing first graders' number sense and whether judgment quality depends on the information use. Accordingly, our research questions are: (1) How do pre-service teachers use information of different validity when diagnosing first graders' number sense?

(2) Does the quality of the pre-service teachers' diagnostic judgment increase when valid information is made explicit?

Methodology

The presented study uses an experimental design to investigate pre-service teachers' information use when diagnosing first graders' number sense. For this purpose, nine authentic text-image vignettes were designed based on literature, each showing a typical classroom situation with a first grader's learning of number sense. Each of the vignettes comprise of a task, a student's solution, notes on the observed solution process and a short teacher-student dialogue. After the validation with experts, four vignettes were provided in three varying information environments which contain: a) additional valid and invalid information about student behaviour, b) additional valid and invalid information about student behaviour, where validity is made explicit and c) only additional valid information about student behaviour. A valid information in the context of number sense is for example the use of manipulatives, an invalid information is for example the social behaviour of the student while solving an arithmetic task. The sample consists of $N=173$ pre-service teachers at the end of a one-semester course covering key topics on the development of number sense. The participants were randomly allocated to the three experimental conditions. Using the Restricted Focus Viewer (RFV) (Jansen et al. 2003), frequency, order, and duration in which the pre-service teachers accessed the different units of information were collected during the experiment. The analysis and comparison of the data between the experimental groups will provide information about the use of the presented information. Additionally, the participants will be asked to write down their diagnostic judgement in order to choose a suitable follow-up task. The analysis and comparison of the answers with the expert norm will show the quality of the diagnostic judgment. The poster presents the theoretical framework and methodology of the study, highlighting in particular the design of the text-image-vignettes and the use of the RFV for investigating the pre-service teachers' use of information.

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