A mathematics teacher's implementation of formative assessment: Overcoming obstacles with adaptive professional development support

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This paper focuses a mathematics teacher's implementation of formative assessment (FA) when helping students solve mathematics tasks. Such FA practice has great potential, but is non-trivial, and teachers will need substantial support for developing their beliefs and practices. We have studied why an engaged and experienced mathematics teacher who had participated in a comprehensive professional development program made certain changes but not others and how additional support helped her overcome obstacles she experienced. The study exemplifies the significance of first-hand information from teachers' classroom practices together with adapted feedback when providing professional development support for their FA development.

Keywords: Formative assessment, professional development, teacher-student interaction.

Introduction

This paper focuses a mathematics teacher's implementation of formative assessment (FA) when helping students who work individually with mathematics tasks. Such work is frequent in mathematics education in many countries (Hiebert et al., 2003), also in Sweden (Boesen et al., 2014), but providing adequate help to students in this situation is challenging. In this study we follow one experienced primary school teacher who had participated in a comprehensive professional development (PD) program in FA and volunteered to additional individual PD support. We sought to understand why even a committed and experienced mathematics teacher who participated in a comprehensive PD did not make the changes in practice that she desired. We study the changes made, the reasons for making certain changes but not others, and features of the additional PD support. The study contributes to knowledge about crucial features of PD in FA.

Background

Formative assessment, its implementation, and PD support

FA is a classroom practice in which teachers and/or students elicit evidence of students' learning needs through assessment and then adapt teaching or learning to these needs. A large body of research conducted in many different subjects at all educational levels has shown that classroom practices that adhere to the principles of FA can accomplish large gains in student achievement, regardless of whether the teachers or the students were the proactive agents in the FA processes (e.g. Lee et al., 2020). This holds true also for mathematics education (Palm et al., 2017). With this background, not surprisingly, FA has been promoted in many countries.

Despite these promotions, high-quality FA is commonly not enacted in schools. Since such practices include non-trivial aspects of classroom practice, teachers need substantial support for developing both their beliefs about teaching and learning and their practices. Research on PD has identified a number of program features important for attaining desired teacher and student outcomes. Examples are instructional resources, hands-on practice, interactive feedback and discussions, time, and

engagement of school leaders and external expertise (e.g. Heitink, 2016). Also, a formative process orientation is pointed out to be a crucial feature of PD programs in FA (Andersson & Palm, 2018).

High-quality formative assessment and its implementation in mathematics education

The present study focuses FA practices where the teacher, as main actor: (1) elicits evidence of student knowledge and skills, (2) interprets the evidence and makes inferences about student learning needs, and (3) gives feedback adapted to these learning needs. The quality of those practices regards the quality of the evidence elicited and the process of using it as information to provide feedback that can support learning. Such FA practices are difficult and complex (Black & Wiliam, 2009), and the use of FA in mathematics accompany specific challenges and changes that rarely come easily (Burkhart & Schoenfeld, 2019). Changes may be giving up intuitive responses such as re-teaching or funneling of students' thinking toward a particular strategy or answer to be replaced by responsive actions which involve taking up and building on students' ideas and thinking (e.g. Jacobs et al., 2022).

Context of the study

The study is part of a three-year intervention project about FA in mathematics. The research group conducted a PD for 25 mathematics teachers at two schools. It was based on previous identified important features of successful PDs (e.g. Heitink, 2016). In the second year, classroom observations revealed that even not all experienced and motivated teachers had implemented all FA practices that was supported in the PD with the quality they aimed for. Additional individual PD support was offered with the intention to target the teachers' specific needs when using FA to help students who work individually with mathematics tasks. The present study focuses on one of these teachers and the following research questions guided the study: Which aspects of the suggested FA practices did the teacher implement and which did she not?; What were the reasons for making certain changes but not others?, and What support helped her to overcome obstacles she experienced?.

Methods

Participants

Elsa (fictious name) volunteered to participate in the study, keen to develop her teaching. She was a committed and experienced mathematics teacher and at the time teaching in Year 6.

Procedure

Elsa audio-recorded her individual help to students during two lessons and sent the recordings to the researchers. From analyzes of the recordings the researchers formulated feedback to Elsa (with examples from the recordings), which was then discussed in a digital meeting between Elsa and one researcher as part of the additional PD. Elsa then used the feedback and attempted to improve her FA practices of her own choice, before a new cycle of co-operation started. The meetings included discussions of Elsa's views of her practice and her beliefs, experiences, difficulties, and successes. The discussions had two purposes: 1) To support her FA implementation; 2) to collect research data.

Data collection

Five teacher-researcher meetings were audio recorded and verbatim transcribed. Other sources of data were the feedback prepared for the meetings, and the recordings from the classroom practice.

Data analysis

To characterize the development of Elsa's FA practices, her classroom recordings were analyzed in relation to the principles and qualitative aspects of FA outlined in the PD. To identify why Elsa made certain changes but not others and to characterize the additional PD support, transcripts from the meetings were analyzed in iterative cycles to identify common themes (see Braun & Clarke, 2006).

Results

Elsa's developed use of suggested FA practices

Before the additional PD support, Elsa struggled to make the students share their thinking and found it difficult to provide feedback that engaged the students in their learning. In her attempts to assess students' needs, several students just answered "I don't know". Elsa tried to push them, using questions such as "What is it that is difficult?". She also used leading questions and asked series of questions with scant room for students to answer. Through her feedback, Elsa tried to encourage the students to take more responsibility but met resistance from the students. During the period of additional PD support, Elsa made progress. For example, she started to use other questions that were easier for the students to answer. She more often insisted on and provided time for students to share their thinking, and occasionally used follow-up questions. Her previous use of feedback pointing out students' successes also got more specific. In addition, from previously taking a leading role in solving the tasks based on her own ideas, she increasingly began to incorporate the students' thinking in her feedback and after giving them hints about how to proceed in their task solving leaving them alone for a while to try to use the feedback.

Reasons for choosing to implement or not implement FA practices

The most salient reasons for not making desired changes had to do with the reactions of the students that Elsa experienced or expected. For example, several students got upset when she insisted that they should share their thinking and Elsa found these students' reactions hard to handle. Moreover, Elsa cared for students' wellbeing and wanted them to enjoy mathematics, which she feared would not be achieved if she demanded too much of them in terms of sharing their thinking or taking responsibility for solving the task. In relation to difficulties of making the students share their thinking Elsa also referred to reasons that had to do with the group constellation. The students did not trust each other and were afraid to reveal shortcomings. Many students with low self-confidence and varying needs made it difficult for Elsa to consistently use the FA practices. Another reason for not using desired FA practices was that she simply forgot, and she referred to the difficulties of abandoning old habits.

Support helping the teacher overcome obstacles

The additional PD provided Elsa with feedback identifying successful uses of the FA practices suggested in the PD, as well as hints about how to develop. Moreover, during the feedback sessions difficulties and reasons (see above) for not using desired FA practices were identified and explored in the dialogue between Elsa and the researcher, and viable ways to implement FA practices were negotiated. Examples of such ways were: introducing changes step by step starting with students who were receptive to changes, providing support and space for students to practice new behaviors, and feedback reinforcing the students' experiences of the benefits of, for example, sharing their thinking.

Conclusion

The research-based PD program provided insufficient support for the use of high-quality FA when helping students individually. The additional PD helped the teacher to make progress regarding both assessment and providing feedback. The study exemplifies the significance of first-hand information of teachers' classroom practices together with adapted feedback for conducting PDs that accomplish large gains in teacher development of FA in the mathematics classroom.

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