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SMART – online formative assessment: Professionalising teachers & enhancing students' understanding

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This project of German Center for Teacher Education in Mathematics (DZLM) sets out to investigate the effects of SMART, an online formative assessment tool, on the professionalisation of teachers and on the development of students' understanding. Formative assessment can be conceptualised as “all those activities undertaken by teachers, and or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (Black & Wiliam, 1998, pp. 7–8). Core elements of formative assessment include eliciting evidence for student learning and understanding, for example, through appropriate tasks, as well as adapting classroom teaching based on the diagnostic information (Black & Wiliam, 1998). In this respect, it is important that diagnoses of students' learning do not remain on a superficial level such as the correctness of a task. Rather, diagnoses should focus on concept images and possible misconceptions of learners. Such deep diagnosis is the basis for teachers adapting their teaching in meaningful ways in order to foster their students' concept development. However, accurate and deep diagnoses usually require a considerable amount of time and effort on the side of teachers which might be the reason why formative assessment with a focus on understanding is often rarely implemented into classrooms. An expedient solution to this problem can be certain online tools such as the Australian SMART-tests (“specific mathematics assessments that reveal thinking”), which were specifically designed for this purpose by a group of researchers at the University of Melbourne (Stacey et al., 2018). SMART-tests provide not only understanding-oriented diagnoses within a few minutes, but also further teaching recommendations and information on common misconceptions. Hence, on the one hand, SMART delivers quick, directly usable results that can be used by teachers to enhance their students' understanding. However, its developers demand further research to scientifically investigate whether the system does improve student learning outcomes in general (Stacey et al., 2018). On the other hand, SMART can implicitly foster teachers' pedagogical content knowledge and thus their diagnostic skills. Nevertheless, “it also seems important to have professional development showing its advantages and distinctive features, and to provide teachers with advice on implementation.” (Stacey et al., 2018, p. 20). Without such support, teachers may use the diagnosis from formative assessment environments more in the sense of a summative assessment instead of developing their teaching in an understanding-oriented way (Stacey et al., 2018).

Therefore, in addition to SMART-tests being adapted and translated for use in German-speaking countries, this project includes the design of an accompanying professional development (PD) programme to scale up the effects on teachers' diagnostic competencies and thereby students' understanding. The study will investigate to what extent teacher competencies, practices and students' understanding in the field of algebra develop through the use of the SMART system depending on

whether teachers take part in an accompanying PD programme:

1. How do teachers' diagnostic and support skills and teachers' self-efficacy beliefs about digital formative assessment develop through the use of the SMART tests?
2. What kind of support do teachers implement in their lessons depending on the type of support teachers receive?
3. How do teachers integrate SMART test results into their teaching?
4. How do students' conceptual understanding and misconceptions develop through the use of SMART?

Figure 1: Research questions

These research questions are investigated by comparing three groups of teachers and their students (see Figure 2). While both first and second group will receive SMART diagnoses and teaching suggestions, only teachers from group 1 will be supported by an accompanying PD programme. Teachers in group 3 (control group) will only receive the corrected results of their students but neither a diagnosis in the form of stages of understanding and misconceptions nor any teaching suggestions.

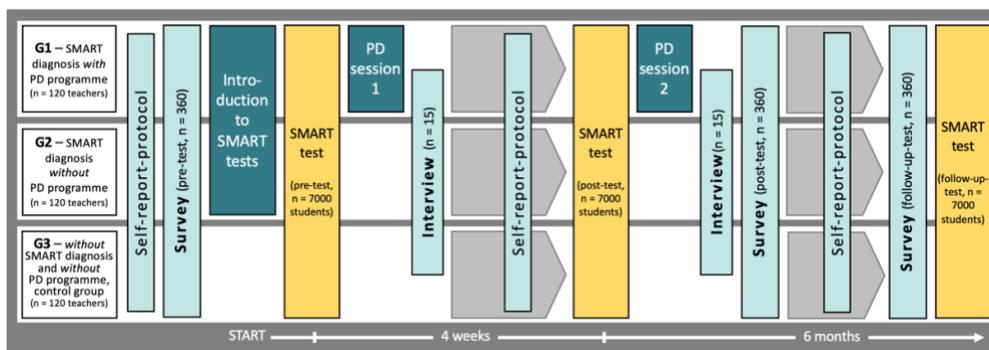


Figure 2: Research design

To answer the research questions, different types of data will be gathered: On the teacher level we assess teachers' diagnostic competencies and beliefs with questionnaires. Additionally, teachers' formative assessment practices in the classroom will be captured by pre-structured self-report-protocol. Furthermore, we conduct qualitative interviews with a subset of teachers from each group. On the student level, we gather data on student understanding by using the SMART-tests.

A first small pilot has shown, firstly, that German students indeed exhibit the misconceptions that were intended to be tested by the Australian developers. Secondly, although teachers acknowledge that knowledge gaps were filled by SMART information, their understanding and conclusions from the information differ considerably. This supports our presumption that additional PD might be helpful to further enhance teachers' formative assessment competencies.

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