

# **Realising formative assessment strategies with SMART – a study of teachers' use of an understanding-orientated digital diagnosis tool in the topic of linear functions**

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## **Theoretical background**

Understanding functional relationships is central in secondary school mathematics education. Even though concepts and typically arising misconceptions in learning functional thinking are widely explored (e.g., Nitsch, 2015), students in Germany still struggle a lot with this topic (Sproesser et al., 2020). A precise diagnosis of students' thinking and a constant attendance to their learning processes are therefore important elements of teaching functions.

Regarding diagnosis and its consequences for instructions, the concept of formative assessment plays an important role. To specify how formative assessment practices can be realised, Black & Wiliam (2009) work out five key strategies which are the basis for several other conceptualisations and specifications of the concept of formative assessment (e.g., Aldon et al., accepted). Empirical studies have shown positive effects of the realisation of formative assessment strategies on the performance of students, but these effects depend mostly on the subject that is taught and on the specific form of implementation (Kingston & Nash, 2011). Other empirical studies have found that the use of digital technologies can support the implementation of formative assessment strategies (Aldon et al., 2017). The digital tool SMART aims at providing this support.

## **The digital tool SMART**

SMART (Specific Mathematics Assessments that Reveal Thinking) is a web-based diagnostic system that was developed by researchers from the university of Melbourne, Australia (Price et al., 2009), and is currently being adapted for German-speaking countries. Teachers may choose from about 130 multiple-choice-tests in several mathematical topics that elicit students' understanding of mathematical issues by focusing on their conceptual knowledge. Within a few minutes, it provides understanding-orientated diagnoses that are based on research results. The tool provides teachers with information about individual misconceptions and also fitting recommendations to adjust their lessons to the needs of their students.

## **Research aims**

On this poster, we present a research project investigating teachers' use of the digital tool SMART with a focus on the realisation of formative assessment strategies. From the theoretical frame explained above, the following research questions derive:

- 1) Which processes, strategies and techniques of formative assessment do teachers implement in their mathematics teaching by using the understanding-orientated digital tool SMART in the topic of linear functions?

2) In which way does the tool encourage teachers to implement processes of formative assessment in their everyday mathematics teaching?

The study follows a mixed-methods design. We will first observe teachers in their mathematics lessons while using the SMART tool to gain some information about the processes and strategies of formative assessment they realise while using the tool. This information will be linked with the theory of formative assessment strategies on the one hand and with the specific knowledge and attitudes of teachers regarding the concept of formative assessment on the other hand. Thus, we aim to reconstruct in a qualitative analysis different types of implementation practices teachers show. With this information, we will then develop a questionnaire to map these types of implementations in a bigger sample and to gain insights into how the tool encourages teachers to realise formative assessment strategies. As the research is still ongoing, the poster focuses on the aim and the design of the project, but will not yet present any research results.

## References

- Aldon, G., Barzel, B., Cusi, A. & Olsher, S. (accepted). Rethinking teachers' formative assessment practices within technology-enhanced classrooms. In B. Pepin, G. Gueudet, & J. Choppin (Eds.), *Handbook of Digital Resources in Mathematics Education, Ed 1*.
- Aldon, G., Cusi, A., Morselli, F., Panero, M. & Sabena, C. (2017). Formative assessment and technology: reflections developed through the collaboration between teachers and researchers. In G. Aldon, F. Hitt, L. Bazzini, & U. Gellert (Eds.), *Mathematics and Technology* (pp. 551–578). Springer International Publishing. <https://doi.org/10.1007/978-3-319-51380-5>
- Black, P. & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability*, 21(1), 5–31. <https://doi.org/10.1007/s11092-008-9068-5>
- Kingston, N. & Nash, B. (2011). Formative assessment: A meta-analysis and a call for research. *Educational Measurement: Issues and Practice*, 30(4), 28–37. <https://doi.org/10.1111/j.1745-3992.2011.00220.x>
- Nitsch, R. (2015). *Diagnose von Lernschwierigkeiten im Bereich funktionaler Zusammenhänge: Eine Studie zu typischen Fehlermustern bei Darstellungswechseln* [Diagnosis of learning difficulties in the area of functional relationships: A study of typical error patterns in representation changes]. Springer Spektrum. <https://doi.org/10.1007/978-3-658-10157-2>
- Price, B., Stacey, K., Steinle, V. & Gvozdenko, E. (2009). Getting SMART about assessment for learning. In R. Hunting, T. Fitzpatrick, J. Milne, D. Itter, D. Martin & C. Lenard (Eds.), *Mathematics – Of prime importance. Proceedings of the 2009 Annual Conference of the Mathematical Association of Victoria* (pp. 174–181). Mathematical Association of Victoria.
- Sproesser, U., Vogel, M. & Dörfler, T. (2020). Typische Lernschwierigkeiten mit Darstellungswechseln bei elementaren Funktionen – Welche Schwierigkeiten kennen Lehrkräfte und wie schätzen sie Aufgabenbearbeitungen ihrer Klassen ein? [Typical learning difficulties with changes of representation in elementary functions - What difficulties do teachers recognise and how do they assess their classes' work on tasks?]. *Mathematica Didactica*, 43(1), 1–24. <https://doi.org/10.18716/ojs/md/2020.1154>