

Design Research in German Mathematics Tertiary Education Focusing on Profession-Specificity

Lena Wessel

University of Education Freiburg, Germany

The poster proposal presents design research projects in the context of German tertiary education for preservice secondary teachers and service mathematics courses. The approach of design research for university students with a content-specific focus on profession-specificity is exemplified by two concrete design research projects.

Keywords: Design Research, Service Courses, Preservice Secondary Teachers, Calculus

In Germany, due to a growing heterogeneity among university students (Heublein et al., 2012) the need for instructional innovations in mathematics and mathematics-related studies is taken very seriously at the moment. Especially in mathematics, also high rates of drop out (Dieter & Törner, 2012) led to an increasing attention to more adaptive teaching as a means of reacting to students' heterogeneity as well as enhancing their motivation. The poster presents research projects of the researcher and her research group on instructional innovations within preservice secondary teacher education on the one hand and mathematics service courses on the other. Although the target groups of the innovations differ in several ways, Design Research as the common research approach is chosen to meet the innovation needs, which will be lined out and motivated.

Design Research is a widely-established research methodology for enhancing and investigating students' learning. It is especially strong when the two aims 'designing learning arrangements' and 'investigating the initiated learning processes and contributing to local instruction theories' are to be combined (Bakker & van Eerde, 2015). The research projects presented here follow a topic-specific approach with a focus on learning processes (Prediger & Zwetzschler, 2013) which is adapted to designing and researching teaching learning arrangements in mathematics tertiary education. The approach is exemplified by two research projects which foster university students' content knowledge and pedagogical content knowledge with a focus on profession-specificity.

Example 1: For preservice secondary teachers, the design research project focuses on pedagogical content knowledge of functional reasoning and calculus. The overarching research question "*How can profession-specific learning tasks be specified and structured and which learning pathways and obstacles can be identified?*" is pursued. The Four Component Instructional Design Model by van Merriënboer & Kirschner (2007) builds the instructional framework being implemented in three cycles of design experiments (laboratory setting). At the moment, data analysis of n=26 students' pre- and post written answers of three learning tasks from the second and third design experiment cycle is ongoing by means of qualitative content analysis (Mayring, 2008).

Example 2: For fostering first-year students' understanding of functions and calculus (and related procedural knowledge) in mathematics service courses, adaptive online remediation modules are designed and investigated. Profession-specificity of the modules is realized by contexts of applications from the field of studies (natural sciences, engineering). Video-taped design experiments at the computer (laboratory one-on-one and partner setting) and the qualitative analysis of the initiated learning processes are much needed, since little is known about how students work with online remediation material and many questions, e.g. concerning adaptive feedback or relations of usability and conditions of success, are still open.

References

- Bakker, A., & van Eerde, D. (2015). An introduction to design-based research. In A. Bikner-Ahsbals, C. Knipping, & N. Presmeg (Eds.), *Approaches to qualitative research in mathematics education* (pp. 429 – 466). Dordrecht: Springer.
- Heublein, U., Richter, J., Schmelzer, R., & Sommer, D. (2012). *Die Entwicklung, der Schwund und Studienabbruchquoten an den deutschen Hochschulen – Statistische Berechnungen auf der Basis des Absolventenjahrgangs 2010*. Hannover: HIS.
- Dieter, M., & Törner, G. (2012). Vier von fünf geben auf: Studienabbruch und Fachwechsel in der Mathematik. *Forschung & Lehre*, 12(10), 826-827.
- Mayring, P. (2000). *Qualitative Inhaltsanalyse. Grundlagen und Techniken* (7. Ed.). Weinheim: Deutscher Studien Verlag.
- Prediger, S., & Zwetschler, L. (2013). Topic-specific design research with a focus on learning processes. In T. Plomp, & N. Nieveen (Eds.), *Educational Design Research: Illustrative Cases* (pp. 407 – 424). Enschede: SLO.
- van Merriënboer, J. J. G., & Kirschner, P. A. (2007). *Ten steps to complex learning*. New York: Taylor & Francis.