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► To cite this version:

Florian Schacht, Petra Scherer, Julia Marie Stechemesser, Karolina Hasebrink, Jessica Bau. Design of digital teaching and learning materials for mathematics teacher education at the university level. Twelfth Congress of the European Society for Research in Mathematics Education (CERME12), Feb 2022, Bozen-Bolzano, Italy. hal-03749064

HAL Id: hal-03749064

<https://hal.science/hal-03749064>

Submitted on 10 Aug 2022

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Design of digital teaching and learning materials for mathematics teacher education at the university level

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Keywords: Digital tools, OER, university mathematics education.

Motivation

In recent years there is a growing body of research concerning the use of digital tools at the university level. Whereas many studies focus mathematical programs like geometry or functional reasoning (cf. Albano et al., 2021), there has been less research concerning the use of digital tools in the context of mathematics teacher education, which addresses both, content-related as well as educational-related topics in mathematics and mathematics education. School-related research suggests, that digital technologies offer the possibility to help students autonomously acquiring mathematical knowledge (Drijvers et al., 2016), which is relevant for teacher training programs, too. Another advantage of digital learning materials is that they are not limited to one institution, as they can be distributed as Open Educational Resource (OER). Hence, OER has the potential to reshape and improve teaching in higher education (Camilleri et al., 2014). Not only the implementation of technological innovations but also their design is of great importance (OECD, 2015).

Goals and objectives of the explorative project ‘DigiMal.nrw’

The development of digital learning materials for mathematics teacher education at the university level, and research on students’ learning processes is the main purpose of the project DigiMal.nrw. The research activities in this project are oriented towards a design-based research approach. Developed materials address both, mathematical content and more didactical, practice-oriented content for learning situations (e.g. in seminars and lectures) and exam situations. The development and use of digital learning materials (e.g. interactive videos) and diagnostic tools (e.g. digital self-checks) shall enhance the individual student teacher’s learning process to understand, reflect and use the content for learning independently of time and location. All digital materials developed will be available as Open Educational Resources (OER) on the (federal) state portal ORCA.nrw (Open Resources Campus NRW), a platform for exchange, communication and the use of digital materials.

Project group and sub-projects

DigiMal.nrw consists of five thematic sub-projects: The sub-projects 'arithmetic', 'geometry' and 'stochastics' refer to mathematical core contents. The sub-projects 'heterogeneity in mathematics classrooms' and 'subject-related language education' address didactical challenges. The project involves all eight universities in North Rhine-Westphalia (Germany) that provide teacher training for elementary school and special education. In this constellation, the project realizes a core idea of OER already in the process of the development: The material is developed and used in teams of different universities, and the material is exchanged within the project group. Hence, when distributing the

material as OER on the platform, it is already exchanged and widely used in different locations so that the potential of further distribution will be increased.

First results

The developed digital learning materials vary in terms of their application and technical realization. The following types of materials have been created so far (most of them designed with the software H5P): 13 self-checks, 3 video based learning environments, in which students create videos, 27 interactive books, 1 digital introductory course, 1 digital learning environment, and several explanatory videos. Figure 1 gives an insight into different excerpts of an interactive book out of the sub-project 'geometry'. An interactive book consists of different pages. Every book page is a combination of e.g. interactive videos, GeoGebra-applets, tips, multiple choice questions, and drag and drop tasks, helping students to learn lecture contents autonomously.

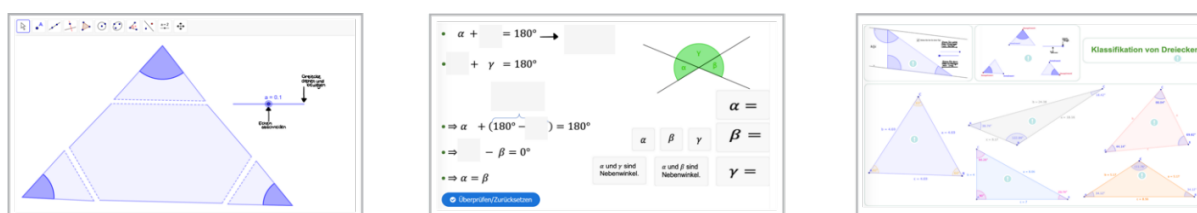


Figure 1: Extracts from interactive books (sub-project 'geometry')

The associated research projects especially address questions like the use of the digital resources. In the case of geometry, for example, first analyses of interviews and questionnaires suggest that the combination of videos, digital tasks and tips in an interactive book supports students investigating geometric proofs on their own and reflecting their work profoundly. Further evaluations will give hints for revising the material and derive implications for the design of digital learning materials.

Acknowledgment: This project is supported by the Ministry of Culture and Science of NRW within the program DH.NRW/OERContent.nrw.

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