A learning environment for pre-service physics teachers on how to diagnose students' conceptions not covered by physics education textbooks

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Abstract. To date, there is a lack of (research on) learning environments for pre-service physics teachers that allow them to learn about and practice diagnosing students' conceptions that are not covered by physics education textbooks. In this study, we developed and piloted such a learning environment. Since coping with the diagnostic process is particularly demanding for preservice physics teachers, our accompanying research aims to identify learning barriers within our developed learning environment. Our contribution presents the design of the developed learning environment and reports preliminary results of our accompanying research.

1 Theoretical Background and aim of the study

Profound diagnostic skills of teachers regarding students' conceptions are essential for adaptive and thus high-quality physics teaching [1]. Many typical students' conceptions are well described in physics education textbooks (e.g., [2]). However, there is also a variety of students' conceptions that physics teachers encounter in their classrooms that are not covered by physics education textbooks ("off-textbook" students' conceptions; e.g., conceptions regarding subsidiary topics within school physics). Consequently, diagnosing ("off-textbook") students' conceptions is an everyday and important, as well as challenging task for physics teachers. During teacher education, pre-service physics teachers should be adequately prepared for this important task. To date, however, there is a lack of (research on) learning environments for pre-service teachers that allow them both to learn and practice diagnosing "off-textbook" student conceptions. In this study, we have developed and piloted such a learning environment focusing on the diagnosis of students' conceptions on the viscous behavior of fluids [4] (an example for "off-textbook" students' conceptions). Since the diagnosis of students' conceptions is very challenging for pre-service physics teachers, our accompanying research focuses on identifying elements within our developed learning environment that promote or hinder pre-service teachers' learning processes in terms of acquirement of diagnostic skills. In this way, the learning environment will be refined by following a design-based research approach [3].

2 Design of the learning environment

The first version of the designed learning environment is attached to an existing module (developed at the University of Graz – for details see [1]) implemented in the physics teacher education program for the south-eastern region of Austria. The existing module, which focuses on the diagnosis of students' conceptions found in physics education textbooks, was expanded by adding a learning environment addressing students' conceptions about the viscous behavior of liquids [4]. In this learning environment (in total a 2½-hour unit) the participants work in

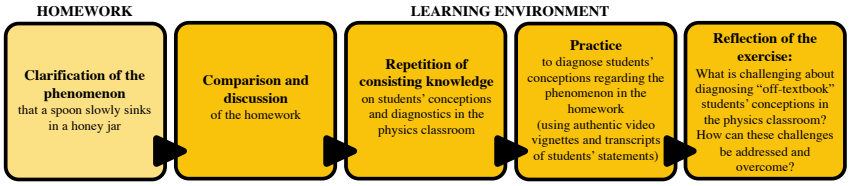

Fig. 1 Structure of the developed learning environment

small groups and practice to diagnose "off-textbook" students' conceptions in authentic statements of secondary school students (presented as video clips and transcripts). The structure of the developed learning environment is summarized in Figure 1.

3 First implementation of the learning environment

In May 2021, we piloted the learning environment for the first time as an online and team-teaching unit for pre-service physics teachers (N = 11, 6th semester) at the University College of Teacher Education Styria (Austria). Thereby, in order to collect valid empirical data for our accompanying research, the entire session (including all group activities) was videotaped. Furthermore, we used a short questionnaire at the end of the unit to receive initial feedback from the students regarding elements of the learning environment that they perceived as (less) beneficial and/or helpful. The feedback from the short questionnaire currently serves as a guiding reference of our qualitative analysis of the video data.

4 Preliminary results of the accompanying research and outlook

Besides several other insights, the feedback from the short questionnaire reveals a heterogeneous perception of difficulty among the participants regarding different content areas (see Figure 2). This suggests that besides supportive elements, our learning environment also seems to contain learning barriers (for some pre-service physics teachers). Consequently, the focus of our qualitative analysis of the video data (especially, the recordings of the group activities) is to identify and characterize these learning barriers to refine our learning environment properly. This video data analysis is still in progress and will be completed by December 2021, so that its results will be presented at the 3rd WCPE Conference.

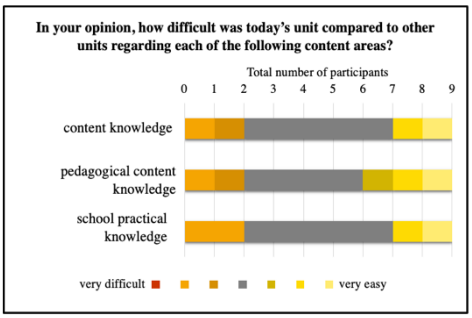

Fig. 2 Participants' difficulty ratings regarding different content areas

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