

Development of a New Study Module about Knowledge Acquisition in Science

Abstract. At the Technical University of Darmstadt, the pre-service teacher study curriculum was restructured as part of the MINTplus² (engl. STEMplus²) project. An important goal of the new curriculum is to improve the STEM education of future teachers and thus the STEM teaching in German schools. In this contribution, a new study module of the new curriculum is presented in which pre-service teacher students deal with the acquisition of scientific knowledge. The module was evaluated with a pre-post test to measure how attitudes towards scientific knowledge generation have changed.

1 Motivation

Many challenges of our global society such as climate change, scarcity of resources or the pandemic are currently being discussed divergently [1]. Media and politicians often use scientific arguments in these contexts. In order to be able to adequately assess the value of such arguments, however, a basic knowledge of the work processes of natural sciences and their self-image (Nature of Science) is necessary [2].

We see it as an important task of school education to prepare students for such social debates and therefore we also see it as an important task of pre-service teacher education to convey this holistic, interdisciplinary view to the acquisition of scientific knowledge. Following the goals of the MINTplus² project of making pre-service teacher education more STEM-oriented and interdisciplinary [3], we have therefore designed a module for future teachers that explicitly deals with the acquisition of scientific knowledge and its communication in the classroom.

2 Development of the New Study Module as a Design-Based-Research-Project

The new study module has a science-integrating approach [4]. It is a counterpart to the classification of pre-service teacher students according to the school subjects biology, chemistry, or physics, which is common in Germany. Didactic theories and practical concepts from the three subject didactic sciences of biology, chemistry and physics are brought together in a completely new way to enable a holistic view of the acquisition of scientific knowledge. Both the holistic view as well as the new content consolidation of the competence “knowledge acquisition” therefore represent together a completely new concept that requires an accurate evaluation.

The Design-Based-Research approach [5] appears to be a suitable research approach for the development and evaluation of this new concept. In our case, the new study module is the “design”, thus central element of this approach. The basis for the development is provided by a comprehensive literature research and empirical data from a student survey from 2019. The results of the survey confirm that in the study curriculum at the Technical University of Darmstadt, interdisciplinary teaching approaches and the competence of gaining knowledge are clearly in the background as opposed to subject-related education.

The new module with the title “Knowledge Acquisition in Science” was designed based on these results and the literature research in 2020. In addition to the discussion of science-integrated teaching, it also includes dealing with experiments and models in science, "Nature

of Science" or the teaching approach "Inquiry-Based Learning", which particularly promotes the conveyance of scientific knowledge [6]. The module was implemented for the first time in 2020 and tested again in an improved form in 2021.

The implementations are evaluated in order to determine their effectiveness. Several evaluation elements such as concept maps, vignettes and questionnaires in pre-post format were used. The contribution focuses on the evaluation of the questionnaire on the scientific attitude of the students. The questionnaire is based on scales from the PISA study [7] and asks students on a four-point Likert scale about their interest in the natural sciences and their ideas about the acquisition of scientific knowledge. The results will be presented in the oral presentation of this contribution.

3 Conclusion

The contribution shows how we designed a new study module for pre-service teachers as a part of a design-based-research-project. In addition to the motivation and implementation of the new study module, we give an insight into the evaluation results of a pre-post questionnaire on the scientific attitude of the pre-service teacher students.

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