

Teaching vignettes for working with Arduino in science teacher education

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Abstract. We developed and researched a course focusing on preparing teacher students for working with Arduino. Based on theoretical foundations and empirical findings, teaching vignettes for reflecting on teaching and learning with Arduino were implemented into the course. The course design was implemented with 13 mathematics and science secondary teacher students in the winter semester of 2022/23. A mixed-methods approach was employed to investigate learning processes of the teacher students. The results show that the course design incorporating teaching vignettes offers teacher students opportunities to experience and reflect teaching and learning with Arduino from both a learner's and a teacher's perspective.

Introduction

The importance of digital aspects in everyday and professional life is increasing due to ongoing digital transformation processes [1]. To prepare school students for participation in this digital society, it is crucial to foster their digital competencies. This requires teachers who are able to provide learning opportunities leveraging digital media [2]. Teacher education therefore needs to prepare teacher students to use digital media to enhance teaching and learning processes [3].

Following the paradigm of Design-based research [4], a course for secondary mathematics and science teacher students is being developed and researched at the University of Graz. The aim is to contribute to the professionalization of the teacher students regarding teaching with and about digital media and to advance their knowledge about science education regarding digital media. One key aspect of this course is the implementation of digital data acquisition with Arduino microcontroller. The learning opportunities of the course were developed based on theoretical foundations and empirical findings [5]. In order to gain insights into the learning processes of teacher students interacting with the course design, the implementation of the course was researched. The results were also used to further develop the course design [5]. After the course was implemented and researched twice, it became evident that many teacher students wished for learning opportunities simulating a teacher's perspective when working with Arduino. Only from a learner's perspective it was difficult for many teacher students to assess their self-efficacy expectations regarding working with Arduino [5]. However, self-efficacy expectations can have a positive effect on the use of digital media in the classroom [6]. Therefore, teaching vignettes for working with Arduino were developed according to Skilling and Stylianides [7] and used in the course. They were intended to help teacher students adopt a teacher's perspective and encourage reflection on their self-efficacy expectation in the context of Arduino.

Research

The implementation of the adapted course design took place in the winter semester of 2022/23 with $N = 13$ teacher students in the bachelor's program of teacher education for secondary levels and was accompanied in particular by the following research questions:

Q.1. To what extent do the teacher students consider working with the teaching vignettes to be helpful in adopting a teacher's perspective?

Q.2. To what extent do the teacher students consider working with the teaching vignettes to be helpful in gaining understanding of school students' learning processes when working with Arduino?

Q.3. To what extent does the teacher students' self-efficacy expectation regarding working with Arduino change after processing the course design?

Methods

Research was conducted on the adapted course design using a mixed-methods approach. Qualitative data was collected using reflection journal entries that the teacher students had written in the digital learning environment of the course (Q.1., Q.2. and Q.3.). On a quantitative level, a pretest before and a posttest after working with Arduino were conducted. In the pretest and posttest, among other things, the self-efficacy expectation of the teacher students [6] to be able to implement digital data acquisition with Arduino was assessed (Q.3.). The triangulation of the quantitative and the qualitative data was thought to provide the best possible insights into the learning processes of teacher students and to inform necessary revisions to the design.

Results and Conclusion

The results show that the use of teaching vignettes as part of the course design proved to be helpful in the given context to offer teacher students the opportunity to adopt both, a teacher's and a learner's perspective and to critically assess their self-efficacy regarding working with Arduino. Among other things, teacher students who indicate a high self-efficacy expectation regarding working with Arduino in the post-test state that when working on the teaching vignettes they were confronted with possible problems related to Arduino that may arise in the classroom and therefore see themselves as capable of supporting students in their work with Arduino.

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