Chapter 6
Developing Storytelling Activities Supporting Computational Thinking Using Educational Robots

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ABSTRACT

Computational thinking and educational robotics are two terms that are increasingly encountered in the literature when discussing the introduction of digital education in primary school. Computer science education is becoming increasingly important, even for young learners. Since its planned implementation in the Austrian primary school curriculum, it became necessary to find appropriate educational required concepts and methods for its implementation. Therefore, a research project was developed to investigate the use of programmable robots combined with the method of digital storytelling. To combine theoretical knowledge with pedagogical practice, the approach of educational design research was chosen. The study was conducted in five classes of primary schools. The aim was to investigate how to design a robotics-based learning environment supporting computational thinking skills. The purpose of this chapter is to give an overview of the findings of this research project.

INTRODUCTION

Computer science education, digital education, and computational thinking have become important terms when discussing education in the 21st century. Digital education has been defined as a key competence for lifelong learning (Kids, 2019) that learners should possess today. Over the years, several competence models, such as DigcompEDU, TPACK (Brandhofer et al., 2018), or digikompP (BMBWF, 2021), have been established for both teachers and students. What is already common practice in many countries, familiarizing the youngest in the education system with computer science education (Rich et al., 2019), will become an issue with its anchoring as cross-curricular competence development in the following

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Austrian primary school curriculum (Kern, 2020). For this reason, the implementation and didactics of digital education are becoming increasingly important. Still, the transfer of innovations and didactic approaches into the classroom is one of the biggest challenges. To introduce computer science education in schools, the playful use of educational robotics offers a possible approach by providing activities that combine analog and digital concepts (Tengler et al., 2021a; Tengler et al., 2021b).

Through research, experimentation, and creative design, students can simulate and visualize phenomena in playful learning environments. Educational robotics (ER) provides access and age-appropriate opportunities to explore students' lives and work digitally. Studies show that playful programming methods with educational robots can promote problem-solving thinking and student motivation (Atmatzidou & Demetriadis, 2016). In addition to traditional approaches to robotics, students are particularly motivated when robotics activities are offered interdisciplinary (Angeli & Valanides, 2020). Although there are already successful individual initiatives (Himpsl-Gutermann et al., 2017) in Austria, where robotics is used in the classroom to promote computational thinking, programmable robots are not currently widely used in schools. However, a close link between theory and practice seems important in computer science education. Initial concepts can be further developed to lead to sustainable innovation and implementation in the classroom (Esteve-Mon et al., 2019). For this reason, a research project with programmable robots is being conducted that focuses on the learning and teaching method of digital storytelling to support the implementation of computer science education using programmable robots and to integrate computational thinking into the classroom across subjects. Since the introduction of computer science into primary education requires practical and theoretical knowledge, educational design research was chosen for investigation, allowing close interaction between researchers and practitioners.

This chapter gives an overview of the theoretical framework. It describes the interdisciplinary approach of the teaching and learning method of digital storytelling. The next step presents the findings on the aspects of enhancing computational thinking skills identified in a previous study of this research project (Tengler et al., 2021b) and confirmed in the following sub-cycle. At last, it answers the research question by proposing how to design a robotics-based learning environment using storytelling supporting computational thinking skills.

THEORETICAL BACKGROUND

Digital Storytelling

The potential of stories to convey information, explain problems, and evoke emotions has found its way into various scientific disciplines under the term storytelling. Digital storytelling is a teaching and learning method that combines traditional storytelling with digital technologies (Robin, 2006). The aim is to create digital stories based on a combination of different artifacts. Although digital stories result from this process, digital storytelling's pedagogical value lies in the process rather than the final product (Otto, 2020). Robin (2006) classifies digital stories into three categories, "personal narratives, stories that examine historical events and stories, that are primarily used to inform or instruct" (p.2). Digital storytelling can be integrated into teaching practice in a variety of ways (Robin, 2006). Kordaki et al. (2017) analyzed the stages of digital storytelling. They proposed an initial framework that highlights the relationship between the stages of digital storytelling and the development of computational thinking skills. By creating interactive stories, students are enabled to improve their digital skills, which can