DATA-RELATED CONCEPTS, PRACTICES AND DESIGN PRINCIPLES FOR TEACHING AI TOPICS IN SECONDARY SCHOOLS

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Introduction

Many countries around the world have started to introduce topics around AI into school education. In 2021, UNESCO reports that 11 member states have developed, approved and implemented AI curricula at different stages of school education, and many more states have K-12 AI curricula in development (UNESCO, 2022). Integrating AI topics into school curricula aims to enable students to use responsibly AI systems, to understand what AI systems are, how such systems are created and how they work.

The process of including AI topics in curricula is timely and much needed, but it is also challenging because the systematisation of the field of AI for school education is still ongoing. Several catalogues of competences, ideas and design principles have been proposed (Long & Magerko, 2020; Michaeli et al., 2022; Tedre et al., 2021; Touretzky et al., 2019). Well known are the Five Big Ideas of AI (Touretzky et al., 2019) or the recommendations based on Dagstuhl Triangle Model (Michaeli et al., 2022). However, there are some serious gaps in the field. Although curricula highlight the role of data, data is still significantly underestimated in current AI education. AI curricula cover only a fraction of the competencies related to data literacy (Olari & Romeike, 2021). Although there are a growing number of educational resources and practical examples of how AI can be taught in schools, current practical examples only scratch the surface of working with data (Olari et al., 2023). Focus group interviews with 196 computer science teachers, conducted as part of "TrainDL - Train Teachers on AI and Data Literacy" - a European project to train teachers to teach AI topics in schools, showed that the lack of evaluated practical examples and teaching concepts is a major obstacle for teachers to integrate AI into their teaching (Martin Reger, Evgenia Samoilova, n.d.; Martin Reger, Evgenia Samoilova, Ulrike Lucke, Anastasia Tsymboulova, n.d.). The need to develop approaches to teaching data-focused AI is therefore one of the key development goals for computing education.

Data-related practices and data-related concepts for teaching AI in schools

In computing education research, there is a strong consensus that teaching should focus on the key concepts of the subject rather than on short-lived technological developments. For this reason, catalogues of ideas, concepts and principles of computing and its subfields have been developed over the past decades. Well known are, for instance, Fundamental Ideas of Computer Science (Schwill, 1994) or Great Principles for Computing (Denning, 2003). Following this tradition, we have conducted a comprehensive technical clarification of the field and elaborated on the role of data for AI education in order to advance the field of AI education and fill the gap of insufficient attention to data. We proposed two models: a model of 28 data-related practices (Olari & Romeike, 2024b) and a collection of 155 data-related concepts (Olari & Romeike, 2024a).

Implementation of the practices and concepts in the school practice

In order to understand how the models can be implemented in real school conditions, we have designed and are currently conducting a design-based research study with 9th and 10th grade students at a secondary school in Berlin, involving computer science and maths teachers as well as professionals who work with climate data on a daily basis. Methodologically, the study is embedded in design research with a focus on learning processes as developed and implemented for subject didactics by Prediger and colleagues (Prediger et al., 2015).

The aim of the study is to investigate the conditions for the success of the subject-specific design principles that we have laid down as a basis for the design of the learning arrangements to develop a local theory of learning processes for teaching data-focused AI in schools. Examples of such design

principles are (1) adopting the method of teaching AI using case studies with unexpected twists to foster critical attitudes towards the data used to build AI systems, an approach that has been used to teach AI and data science in higher education (Hicks & Irizarry, 2016), but also in subjects such as law, economics and medicine (Habasisa, 2014), (2) immersing students in the subject area where the data comes from before building AI systems to give them an intuition that a superficial understanding of the data and its quality could lead to false and devastating implications, (3) owning the data collection and engineering features to give a sense of how much human rather than machine is responsible for the process of building an AI system.

The main research questions we are pursuing in this process are:

- What are subject-specific design principles and success conditions for implementing teaching-learning arrangements on data-focused AI in school practice?
- How do students' knowledge and motivation change during the course?

To organize the design research and design the theoretically salient learning arrangements, we follow the approach of Conjecture Maps - "a method for articulating the joint design and theoretical ideas embodied in a learning environment in a way that supports choices about the means for testing them", as proposed by Sandoval (Sandoval, 2014).

Outlook

In the symposium, I will give an overview of the model of data-related practices (Olari & Romeike, 2024b) and the collection of data-related concepts (Olari & Romeike, 2024a). To further advance the field of AI education, it would be beneficial to discuss the subject-specific design principles that have been established as a basis for implementing the models in the school context, as well as the preliminary results of the study.

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