Providing AI Literacy in Schools – Two Sides of a Medal

Artificial intelligence (AI) is currently one of the most important and disruptive technologies and already has a strong influence on research, society, and people's daily lives. For economic and social participation and as a basis for an informed discourse in the sense of the responsible citizen, a solid basic knowledge of this future technology is therefore indispensable, also known as AI Literacy.

One cornerstone to achieve this is the development and evaluation of age-appropriate content and methods for teaching Artificial Intelligence. Thus, we aim to develop age-appropriate didactic concepts for teaching Artificial Intelligence topics in schools. The methods developed should be based on the current state of research in the field of teaching-learning research and the subject didactics and reflect a broad mix of formats (from pencil & paper to unplugged to programming tasks). The topics to be addressed will be defined in accordance with the Austrian school curricula. The developed concepts will then be evaluated in school lessons in field studies. The corresponding metrics and evaluation tools will also be developed for its methodologically sound evaluation. It also needs to be investigated which competencies of teachers are necessary for a successful implementation of the concepts and how these can be well-founded and effectively integrated into education as well as further education and training.

These goals are two sides of the same medal. The development and evaluation of methods and materials for AI teaching presents a student-centered view of AI Literacy. But we also need to take a teacher-centered view and focus on the necessary skills of teachers and how these can be soundly and effectively integrated into the training of educators.

Although traditionally the teaching of AI has been at the university level, a number of methods, teaching/learning materials, projects, and initiatives have developed in recent years for the teaching of AI in the age groups from 10 to 19. One outstanding initiative is AI4K12 by Dave Touretzky and colleagues, where guidelines and materials for teaching AI were developed in cooperation with the Computer Science Teachers Association (CSTA). In order to do justice to the breadth of the topic of AI, from symbolic approaches such as planning and reasoning to sub-symbolic approaches such as machine learning, as well as the fast pace of technology, the 5 Big Ideas in AI (Perception, Representation & Reasoning, Learning, Natural Interaction, Societal Impact) were defined, similar to the Fundamental Ideas of Computer Science, which function as guiding themes here. Based on this, a variety of formal and informal courses and teaching/learning materials have been developed.

The fundamental difficulty with these materials is that they are often produced ad hoc with technical expertise but without consideration of learning theories and developmental models. In addition, these approaches almost always lack scientifically based evaluation of teaching methods, course organization, and teaching practices that allow the quality and impact of the initiatives to be assessed. Based on preliminary projects on AI Literacy (EDLRIS, ENARIS), the aim is to identify relevant AI topics (e.g. definition of AI, machine learning, ethics) in line with the Austrian SEK I &II curriculum and to develop sound age-appropriate didactic concepts for teaching. Here, challenges at the interface between AI as a technology, didactics, and developmental psychology will be addressed. In a further step, a scientifically sound concept for the evaluation of the developed methods will be developed and thus the methods will be evaluated in a broad representative field study.

Furthermore, based on the idea of the Technological Pedagogical Content Knowledge Framework (TPACK), the aim is to investigate what technological (T-Technology), pedagogical (P-Pedagogy), and content (C-

Content) knowledge (K-Knowledge) is needed to enable teachers to teach AI in an efficient, purposeful and technology-supported way. The framework focuses strongly on the interfaces of the different knowledge areas and thus allows the challenges for the teaching staff to be worked out holistically. In later work, the context (e.g. school level, available resources) was integrated as an important component in the framework.

Kim and colleagues are already using TPACK to derive requirements in relation to AI teaching for teachers. In this first step, an attempt was made to define the necessary skills in relation to TK (e.g. programming), PK (e.g. project-oriented work), and CK (e.g. basic neural networks) from AI curricula in schools in China, Australia, Korea, and India.

Based on the solid foundation of the TPACK framework and the preliminary work in the field of AI teaching in other regions of the world, the necessary requirements for teachers to enable sound, interesting, and contemporary teaching of AI will be systematically investigated for the Austrian and European context. These findings will be integrated into the basic and further training of teachers in the subject of computer science and digital basic education, and their effectiveness will be evaluated in well-founded field studies in the classroom. The corresponding concepts for teacher training and evaluation are to be developed in close cooperation between technology providers such as the Graz University of Technology and training institutions such as the University of Teacher Education Steiermark.

These topics will be investigated in the newly founded Doctoral Program "FutureDEAL – Future of Digital Education and Learning" funded by the Austrian Federal Ministry of Education, Science and Research. During the workshop we aim to motivate the challenges raised in the context of AI Literacy for youngsters, to discuss them, and to present preliminary results of the research conducted.