Introduction of Artificial Intelligence Literacy and Data Literacy in Computer Science Teacher Education

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ABSTRACT

The integration of artificial intelligence (AI) literacy and data literacy into school education is increasingly proposed in educational frameworks, leading to an urgent need to train computer science teachers in AI and data literacy. However, there is a lack of professional development programs for these skills. To fill this gap, we developed a training concept and evaluated it with computer science teachers from Germany, Austria, and Lithuania in three sessions. In the following, we present selected evaluation results.

CCS CONCEPTS

• **Computing methodologies** → *Artificial intelligence*; • **Applied computing** → *Education*; • **General and reference** → *Empirical studies.*

KEYWORDS

data literacy, artificial intelligence literacy, teacher education, action research, mixed methods

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1 INTRODUCTION

In order to thrive in a data-driven world, school students need to become familiar with artificial intelligence (AI) from an early age [10] and develop *AI literacy* and *data literacy* (AI&DL). The former is a set of competencies that enables individuals to understand and critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace [5, 6]. The latter is the ability to collect, manage, evaluate, and apply data, in a critical manner [8]. However, the key to successful integration of AI&DL into school education is effective teacher preparation. Despite the growing body of research on AI education, there is a lack of knowledge about AI teacher training programs for K-12 education, according to a recent literature review [9].

Through our research, we are taking a step toward research-based teacher education in AI&DL. Informed by the requirements for professional teacher development programs that we gathered in a dialogue with European stakeholders and by reviewing European educational policies, we developed a one-day professional development program for in-service computer science (CS) teachers with no to some prior knowledge in AI&DL and evaluated it with CS teachers from Germany, Austria, and Lithuania under the guidance of the following two research question: (1) What is the effect of the designed program on teachers' perceived competence to incorporate AI&DL into their teaching and on their understanding of AI&DL concepts?; (2) To what extent are teachers able and willing to incorporate AI&DL content introduced in the program into their teaching, and what are the potential barriers?

2 DEVELOPMENT OF THE CS TEACHER TRAINING

We developed a one-day (7-hour) teacher training concept that includes two components: (1) content knowledge (based on the Dagstuhl triangle framework [2]) and (2) pedagogical knowledge. In terms of content knowledge, we focused on fundamental paradigms of rule-based AI, supervised, unsupervised and reinforcement learning (AI-related content) and the data lifecycle (DL-related content),

as these are recurring themes in international AI&DL frameworks [5, 6]. For the pedagogical knowledge, we based the training on the *didactic biplane* which is commonly used for CS teacher training [11]. We used research-based open-source unplugged learning materials for machine learning and rule-based AI published under a free license by Wissensfabrik [7]. For the data lifecycle, we chose the computer-based activity in Orange3 [4], also published by the Wissensfabrik [7].

3 RESULTS AND CONCLUSION

We evaluated the impact of the training concept in three sessions with 70 CS teachers from Germany, Austria and Lithuania using a pre- and post-evaluation survey, an AI&DL self-assessment and knowledge test, and semi-structured personal interviews. The results of the evaluation showed that the training in all three countries had some positive impact on teachers' perceived competences on how to use AI content in class, as well as teachers' understanding of AI concepts introduced in the training. Results were mixed for DL content: improvements in this area showed high variability with no apparent increase after training. Participants in all three countries reported that the training served as a valuable introduction to AI and DL. However, the depth and complexity of certain topics, especially in the realm of AI, were challenging for participants. Exercises using the Orange3 tool consistently received mixed feedback. While some teachers found it suitable for teaching, others found it too complex and criticized its graphical interface and lack of programming features as a deterrent for more advanced students. In terms of teachers' perceived ability and willingness to integrate the AI&DL into their teaching, participants highlighted several difficulties. While teachers felt more prepared to integrate the AI&DL content presented in the training into their classrooms after attending the training, integration would require further engagement with the material. A single 7-hour course was not sufficient to ensure the integration of DL and AI into the classroom, especially if teachers had not taught these subjects prior to the training. Teachers expressed a strong desire for further training, concrete course plans and materials tailored to specific grade levels to streamline integration into teaching and reduce their preparation workload, which corresponds with prior research on professional training programs for CS teachers [1]. The main barriers for CS teachers to implement AI&DL in their classrooms were lack of knowledge and time constraints such as current workload. Through our findings, we hope to raise awareness of teacher training within the AI education research community and shed light on how to design and evaluate the impact of the professional development program for AI&DL. As we are following the action research approach [3] in developing, implementing, and evaluating the teacher training concept, we would like to discuss our interim results within the research community. This exchange could be particularly valuable as we also explore ways to effectively evaluate the long-term impact of the training in future work.

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