Promoting Artificial Intelligence and Data Literacy within Teacher Education

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Abstract. With the rising emphasis on integrating Artificial Intelligence (AI) and Data Literacy (DL) into school education within global and European educational frameworks, the demand for training teachers in DL and AI literacy has become pressing. Nonetheless, the current landscape lacks comprehensive professional development programs to address these needs. To address this gap and establish effective implementation of data and AI competencies in teacher training, we engaged in a collaborative effort with policymakers from Germany, Austria, and Lithuania. Our approach was rooted in action research, facilitating the development of a tailored teacher training program. We propose an initial approach that employs the data lifecycle to contemplate on DL skills pertinent to AI. The outcomes serve as a groundwork for constructing a comprehensive strategy for training K-12 educators of all disciplines in AI and DL. This work overviews the project "TrainDL - Teacher training for Data Literacy & Computer Science competences" objectives and implementation.

Keywords: Artificial Intelligence Education · AI Literacy · Data Literacy · Teacher Training · K-12 education

1 Introduction

Teacher training initiatives are actively underway in Austria, Germany, and Lithuania, with a specific focus on cultivating Data Literacy, Computer Science / Informatics competences. The central objective is to enhance the transferability of digital education skills. The project TrainDL (https://train-dl.eu/en) consortium's immediate goal is to determine the optimal integration of Data Literacy (DL) and Artificial Intelligence (AI) competences into teacher training

programs. This integration encompasses both university-level education and professional development for in-service teachers, particularly Computer Science (CS) teachers and also those within the STEAM fields, and primary school teachers. Key stakeholders, including pre-service and in-service teachers, as well as policymakers in the education domain are actively engaged. Through a participatory approach grounded in systems thinking and action research, the project is currently testing hypotheses, evaluating measures, and assessing their applicability over three distinct project cycles. This collaborative process is fostering ongoing knowledge exchange and establishing a metric to gauge the present status of DL and AI literacy within Computer Science education, ultimately leading to the establishment of a European teacher education monitoring system. Building upon these insights, the project will provide curriculum recommendations as well as a policy monitor for DL and AI, aimed at directly impacting relevant national and European stakeholders.

2 Data Literacy and Artificial Intelligence in School Education

The research landscape in AI has more than doubled since 2010, with certain areas like ethics experiencing a rapid surge in recent years [2]. In response to the rapid pace of technological advancements and resulting societal shifts, researchers, educators, and policymakers are increasingly acknowledging the importance of introducing students to concepts such as data collection, understanding, evaluation, and the critical application of AI technologies from an early stage [5]. Data Literacy can be defined as "[...] the ability to collect, manage, evaluate, and apply data in a critical manner" [4]. Efforts to integrate data and AI literacy into K-12 education have been ongoing for years, aiming to equip young learners with the skills needed to excel in a data-driven world [3]. However, the key to effectively integrate AI and Data Literacy (AI&DL) into school education lies in adequately preparing teachers as well as in the proper curriculum support. UNESCO's recent report highlighted that only 11 countries approved K-12 AI curricula by 2021 [6]. While international frameworks exist, such as OECD's AI policy observatory and the EU's DigComp/DigCompEdu, European countries vary in implementation and may have their own policies.

3 Development of Teacher Training: Methodology

To comprehend the scarcity of teacher training programs in AI&DL and to bridge this gap, we embraced an action research approach. Action research is iterative, involving cycles of planning, action, observation, feedback, and reflection. The project protocol contains three phases iterated three times throughout the project roadmap: The policy dialogue & building with a close integration of public authorities (A), the intervention with the field research and experimentation phase (B) and the evaluation on a micro (pedagogical), meso (organizational/structural) and macro (policy) level (C). The evaluation flows into the

policy dialogue and thus guide the intervention of the next phase (see Figure 1). In this poster, we concentrate on the initial action research cycle on level B.
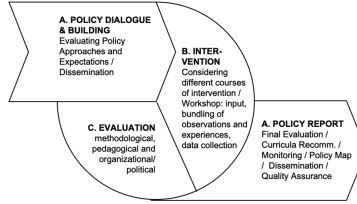

Fig. 1. Project lifecycle phases

Phase 1 - Grasping Practice: We studied the incorporation of AI&DL in school education and the availability of teacher training. Subsequently, we analyzed educational policies, engaging with policymakers and stakeholders in Germany, Austria, and Lithuania to discern factors relevant to teacher education in AI&DL. Phase 2 - Intentional Enhancements: Based on our findings, we devised a one-day AI&DL training program specifically tailored for secondary-level and primary-level. Phase 3 - Implementation and Observation: We executed the training program across Germany, Austria, and Lithuania, gauging its effectiveness through evaluation. Our approach remained reflective, fostering ongoing discussions within the research group and stakeholders.

When designing the teacher training program, we carefully considered the demands of policy requirements, insights gleaned from prior research in AI&DL within school education, and the TPACK model [1]. Our primary focus was on in-service teachers. In terms of content knowledge, which is the first facet of the TPACK model, we concentrated on core concepts such as rule-based AI and machine learning (ML) paradigms (including supervised, unsupervised, and reinforcement learning) and the essential data lifecycle. These concepts consistently emerge as pivotal themes across AI literacy and data literacy frameworks. Furthermore, we introduced educators to their national school curricula and AI&DL guidelines, informed by our policy research. Addressing pedagogical knowledge, the second aspect of the TPACK model, we structured the training around the didactic biplane method, a widely adopted approach in German-speaking regions for CS teacher training. Employing this technique, the facilitator assumes the role of a classroom teacher, while participating educators embody students, engaging with materials as they would in their own classrooms. Adhering to policy recommendations, our training incorporates unplugged resources and computer-based activities that teachers can seamlessly integrate into their teaching practices. Our selected computer-based activity for the data lifecycle employs *Orange3*, a user-friendly visual modeling tool that requires no programming skills, also *Google Teachable Machine*, an online tool which helps to better understand how AI based solutions can learn from data.

4   Conclusion

The TrainDL teacher training concept's evolution was shaped by close engagement with European policymakers, ensuring alignment with their perspectives. The formulated teacher training framework was subsequently put into action and quantitatively and qualitatively evaluated in Germany, Lithuania, and Austria. A one-day teacher training program had a notable positive impact on perceived and demonstrated AI competence. Across the three countries, quantitative findings indicated improved classroom integration of AI content. While DL enhancement varied, AI comprehension consistently improved. Teachers' viewpoints for incorporating AI&DL highlight a strong inclination towards integrating these topics into framework curricula. It is observed across all countries that formal curriculum anchoring is not a prerequisite for teaching these subjects. The prevailing consensus, also among the policymakers, is that AI&DL should form a part of teacher trainings. Additionally, there is a clear call to enhance and expand professional development opportunities in this domain. Our journey provides insights into multifaceted AI&DL teacher training, from stakeholder engagement to policy alignment, training effectiveness, and content preferences.

Acknowledgement

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