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"NAVIGATING THE DIGITAL FRONTIER" TEACHING DATA SCIENCE AND AI SKILLS IN THE AUSTRIAN SCHOOL SUBJECT DIGITAL LITERACY

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Focus Topics: AI and Data Science Curricula and Implementation in School

Introduction

The rise of accessible generative artificial intelligence (GenAI), exemplified by tools like ChatGPT, has sparked critical discourse about its role and implications across various fields, particularly education (Adeshola et al., 2023). This has led to a heightened focus on the role of data science and artificial intelligence (AI) in both academic discourse and public policy. However, the potential of AI and data science in education extends far beyond GenAI applications. This includes fostering a comprehensive understanding of machine learning (ML), data analysis, statistics and ethical considerations to prepare students for the demands of a data-driven world. In the context of education, a key question is what competencies school students should have in the field of AI and data science, and whether they can be trained sufficiently in this area (Adeshola et al., 2023; De Florio-Hansen, 2020). Even though data science topics, particularly AI, have been subject of intensive research in the field of education for several years, the fundamental concepts and backgrounds have been taught almost exclusively at the university level. There is a notable absence of systematic and substantiated approaches that focus on teaching data science concepts at the primary and secondary school levels (Schirmer et al., 2023).

Motivation and Aim

This necessitates the presence of three key elements: *firstly, qualified teachers who are conversant with relevant (complex) data science and AI concepts; secondly, appropriate teaching resources and a guide for relevant data science competencies in schools; and thirdly, a suitable school framework in terms of school subject(s).* These points will be examined in more detail in this contribution by focusing on the recently introduced compulsory Austrian school subject, "Digital Literacy", which provides an opportunity to anchor the topics of artificial intelligence, technology and data science in the curricula of the lower secondary school (Kandlhofer et al., 2021; Micheuz, 2023; Schirmer et al., 2023).

This subject was implemented as a result of the Austrian "Digital School" strategy and, in particular, in response to the challenges posed by the global pandemic of COVID-19. The subject of "Digital Literacy" has been implemented as a mandatory subject for students in the 5th to 7th grade of Austrian secondary schools and is also a required university class for all students enrolled in a teacher training programme at Austrian universities (Kandlhofer & Ehardt-Schmiederer, 2023; Lehrplan Digitale Grundbildung, 2022; Micheuz, 2023). Therefore, a particular emphasis in this contribution is placed on teacher training at universities to ensure that data science and AI skills can already be imparted during the respective undergraduate education and on those teachers who are currently teaching the respective subject.

In implementing the subject, the Austrian Ministry of Education identified first eight overarching areas within the school curriculum, ranging from media literacy to sociological aspects of media and computational thinking (Fehrmann & Zeinz, 2023; Lehrplan Digitale Grundbildung, 2022; Micheuz, 2023; Nárosy et al., 2022). The precise way AI and data science topics are integrated is not clearly defined and will be defined in near future in an updated curriculum. The existing learning objectives for data science and AI literacy are formulated in a vague manner and encompass a wide range of topics, including the description of how artificial intelligence affects numerous software and physical systems, the analysis of the opportunities and risks associated with the use of personalised media, the reflection on the limitations and potential of AI, and the recognition of the boundaries and

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possibilities of digital technologies and media, as well as the ability to "creatively challenge the norms" associated with these technologies (Lehrplan Digitale Grundbildung, 2022; Nárosy et al., 2022; Schirmer et al., 2023). The Austrian Ministry of Education identifies the individualisation of learning processes and the support of teaching staff as the primary potential of AI-based systems in the field of education. For students, this entails the strategic application of generative text AI for tailored feedback and automatic corrections, the comparison of their own texts with AI-corrected versions, and for educators, the development of automated collections of ideas, for instance for exam preparation, up to the design and generation of fully-fledged lessons (Schrimer et al., 2023). It is therefore pertinent to inquire whether this represents a well-utilised potential of data science and AI in school education, or whether there are alternative competencies that should be taught in these complex fields. Established competence frameworks for data science and AI literacy could be used for this purpose, such as the competence model published by UNESCO for both teachers and students (Cukurova & Miao, 2024).

Methods

However, its implementation reveals significant gaps: the learning objectives for AI and data science are broadly defined, and teachers often lack the confidence or resources to deliver these complex topics effectively (Kandlhofer et al., 2021; Lehrplan Digitale Grundbildung, 2022; Nárosy et al., 2022; Schirmer et al., 2023). To address this, a planned study will investigate the perceptions and self-efficacy of teachers and pre-service educators in teaching AI and data science skills within the subject *Digital Literacy*. The research aims to identify which competencies teachers believe are most relevant and feasible to implement, based on established and, above all, state-of-the-art competence models such as those of UNESCO (Cukurova & Miao, 2024), as well as to uncover perceived limitations that could hinder the teaching process. The survey will assess teachers' self-perceived abilities to teach topics such as data ethics, the basics of AI algorithms, and critical analysis of data-driven decision-making systems. It will also explore teachers' views on the societal and educational relevance of AI and data science and their willingness to engage with these subjects. The findings will inform strategies for addressing gaps in teacher training and curriculum design.

Conclusion

In this context, it might be beneficial to incorporate AI and data science into the overall school curriculum as a "multi-perspective" subject and anchor important fundamental skills in the subject of Digital Literacy. The respective topics should be presented from a technological, socio-cultural and application-oriented perspective (Döbeli-Honegger, 2023). In the majority of cases, the technological perspective is not yet given sufficient emphasis. Prior to communicating the functioning of AI tools to students, it is first necessary to convey a comprehensive understanding of these tools to the teachers. This is also essential for the assessment of potential and limitations. It requires a student-oriented approach to the structure and operation of artificial neural networks, as well as the introduction of algorithms and machine learning methods within a context that is comprehensible to the learner (Schirmer et al, 2023). These skills could also be taught to future teachers as part of Digital Literacy class(es) at the university training programme.

Summary

In summary, this presentation should critically reflect on the existing Austrian curricula of the teacher training programme and the secondary school curricula of Digital Literacy, reflect on teaching strategies for AI and data science for future teachers, and above all, discuss which skills students should learn. To this end, a preliminary conceptualisation of the empirical survey is also presented, which should help to better understand which hurdles are currently identified by teachers regarding AI and data science literacy in the subject of Digital Literacy and determine their self-assessment of teaching these fundamental skills. This should also help to define a position for future recommendations in the context of a restructuring the curriculum that is adapted to the current needs in terms of teaching AI and data science in schools.

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