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AI-based Argumentation Tutoring – A Novel System Class to Improve Learners' Argumentation Skills

ABSTRACT

Argumentation is an omnipresent foundation of our daily communication and thinking. The ability to form convincing arguments is not only the fundament for persuading an audience of novel ideas but also plays a major role in strategic decision-making, negotiation, and productive civil discourse. However, students often struggle to develop argumentation skills due to a lack of individual and instant feedback in their learning journey, since providing feedback on the individual argumentation skills of learners is very time consuming and not scalable if conducted manually by educators. Following a design science research approach, we propose a new class of argumentation learning systems that provide students with individual and ongoing tutoring to support them in learning how to argue. We build our socio-technical design on a combination of user-centered design principles, a conceptualization of argumentation structures in student-written text, and Natural Language Processing and Machine Learning classifiers to provide individual feedback. To investigate if the new system class of AI-based argumentation tutoring systems helps students to improve their argumentation skills, we evaluated the novel artifact class in two empirical studies in comparison to traditional argumentation learning systems. In a laboratory experiment (study 1), as well as in a field experiment in a large-scale lecture over three months (study 2), we found that AI-based argumentation tutoring systems based on our design principles, argumentation schemes, and algorithms improve the short- and long-term argumentation skills of students significantly compared to the traditional argumentation learning approaches.

Keywords: *Adaptive Argumentation Learning, Metacognition Skills, Design Science, Adaptive Skill Learning, Artificial Intelligence for Education*