AI-Supported Acquisition of Argumentation Skills: Use Case 'The Argueniser'

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Abstract. A growing number of students enrolls at universities, while capacities – above all in terms of teachers – to support their learnings stay limited. In particular, individualised feedback for students is not feasible in many courses. How can universities close this gap with the help of Artificial Intelligence (AI)?

This paper presents a use case for an AI-aided learning scenario that is expected to achieve high learning effectiveness: the acquisition of argumentation competence in the disciplines of law and economics. Emphasis is placed on good comprehensibility for the target group of students, despite the complexity of the setting. Also for this reason, the use case has been given a descriptive name, The Argueniser - Organise Your Arguments.

The focus of this paper is placed on the use case. Flanking topics are also highlighted: the concept of argumentation competence within the project, the role of feedback, and mutual learning between learners, teachers and AI. A preliminary study design illustrates the approach to measure learning effectiveness of the AI-aided learning situation. A notable aspect of the project is the involvement of the instructional design perspective already in the training phase of the AI.

DEEP WRITE is a project funded by the German Federal Ministry of Education and Research (BMBF) that aims to improve university teaching using AI. This paper is developed in the context of this project and it is based on thoughts developed within the team.

Keywords: Educational Design Research · Design-Based Research · AI-Aided Competence Development · Argumentation Competence · Toulmin Scheme · legal opinion style · ARS

1 Introduction

The work-in-progress paper contributes to a higher teaching quality in Higher Education. An innovative educational intervention will be developed to reach better learning outcomes. An overall view will be given about the ongoing pedagogical considerations and the implications for the development of a first prototype as well as about a following evaluation. The work follows a design-based research approach with the phases analysis, design, evaluation (McKenney 2012, p. 135).

Teaching quality consists of three basic dimensions: classroom management, cognitive activation and student support (Praetorius et al. 2018). A typical classroom management teaching scenario in lecture halls with a great many of students and only one

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person as mentor has the weakness of individual support for each student. Large sessions in the disciplines of law and economics at the University of Passau with more than 400 participants, especially in the basic courses, form the field for testing the use case for cognitive activation presented in the paper.

AI-technologies seem to promise a better learning experience for each student even in this type of university lectures. The AI in the project will be able to automatically evaluate texts of students as well as to give instant and effective feedback. It takes on the role of a computer-simulated personal mentor (EDUCAUSE 2017, p. 2) in this process. Students in mass study programs will be able to receive individual feedback on their performance in order to significantly improve their practical skills.

The presented use case 'Argueniser' is implemented into ClassEx, an advanced ARS that allows to configure complex intervention settings in stages. It integrates Mazur's effective Peer Interaction active learning strategy (Crouch and Mazur 2001, p. 975), while at the same time is capable to display AI-generated feedback. The Argueniser does not replace academic teaching with 'edutainment', but acknowledges the fact that 'Although enjoyment and interactivity do not determine learning, they are necessary conditions which predicate learning.' (Wood 2020, p. 24). In the use case, it is tried to keep up learners' intrinsic motivation through increasing interest, managing expectations, and clear goalsetting (Reinders 2015, p. 57).

As indicated by the design based research and the three basic dimensions of teaching quality, the approach taken in the project is marked by a high learner centricity. The individual learner, the learning experience and the target competencies set the frame for the intervention. The disciplines involved are brought together in a Learning Experience Design setting, usually consisting of pedagogical and psychological aspects, the subject domains as source of knowledge, and software development (Ebner 2021, p. 3). There is an interplay of the different disciplines designing the effective teaching-learning process.

In DEEP WRITE it is the following disciplines who contribute to the overall project: Data Science with a focus on Natural Language Processing (NLP), the knowledge domains of economics and law, ClassEx, the ARS system used in the project, and educational sciences. The different disciplines jointly plan, accompany and evaluate the use of AI in practical teaching, facilitate the formulation of learning objectives and develop feedback strategies and assessments.

2 Analysis

What makes a good written argumentation? The definition presented below takes into account different perspectives, ranging from existing writing and argumentation competency models, literary practices, taxonomy models, to study and examination regulations of the subject domains in the project (cf. Anderson 2001; Becker-Mrotzek 2022; Feilke 2016; Fix 2008; Sieber 2005; Toulmin 2003).

In the DEEP WRITE project, the term argumentation competence means the written argumentative discussion of an issue or a question within the disciplines of law and economic sciences. The argumentation formally follows a set pattern, legal opinion style ('Gutachtenstil') in the legal context, and the Toulmin scheme in the context of economics. In the DEEP WRITE project, argumentation competence includes not only the application of argumentation models, but also the convincing presentation of positions,

for which content and arguments must be selected, weighted and arranged according to their relevance, correctness and completeness. Knowledge of norms and values, subject knowledge, world knowledge and language knowledge are also required.

The German Gutachtenstil and the use of language in law in general follows strict rules 'and the recourse to fixed formulas and locutions, which give little room for any individual variation.' (Bourdieu 1987, p. 819): The German Gutachtenstil, a specific legal opinion argumentation scheme as presented in Fig. 1, clearly regulates how a legal argumentation must look like in order to meet the quality criteria of the discipline of law. The Gutachtenstil is mainly used in law studies up to the First State Examination in Germany. In the practice of jurisprudence and administration, the verdict style dominates. Here, the result is put first (not the problem) and then systematically justified. This specific legal opinion argumentation scheme differs from the Anglo-American style of written argumentation.

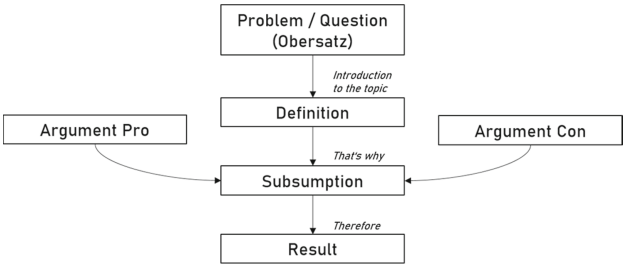

Fig. 1. The German legal opinion argumentation scheme (own visualization)

Based on the definition of argumentation competence provided above a preliminary criteria catalogue to rate student argumentative texts is being produced. The criteria are being located in the learning objectives taxonomy (LOT) (Anderson 2001, p. 28) (Table 1).

Table 1. Proposed evaluation criteria (own compilation)

Priority	Criteria catalogue	Expectation horizon	LOT
1	Argumentation structure (textualisation)	Student knows the domain specific argumentation model and applies it	C3 (procedural)
2	Correctness of content (referentialisation)	Student chooses correct content for argumentation and applies it	A3 (factual)
2	Relevance of content (alterisation)	Student evaluates and weighs the content of his/her argumentation	A5 (factual)
2	Completeness of content	Student must select and apply all appropriate content	A3 (factual)
3	Knowledge of norms and values	Student applies knowledge of general principles and models	B3 (conceptual)

3 Design

The Argueniser – Organise Your Arguments is a scaffolding exercise that provides the students with knowledge about the structure of an argumentation (Fig. 2). It transfers the theoretical framework of the respective argumentation schemes into a learning exercise within an ARS. The argumentation elements are labelled and explained. The exercise as cognitive activation is considered to be most effective when the following four phases are planned: declarative knowledge acquisition, reference to examples, forming rules, and lastly automation and flexibility allowing learners to transfer their knowledge to new tasks (Philipp 2021, p. 102–103, cf. Renkl 2014).

For economics, the Toulmin scheme is applied, offering Claim, Evidence, and Warrant as open text fields. For the German Gutachtenstil, open text fields are offered for the General Question, the Factual Requirements, the question whether the condition is fulfilled (Obersatz), the Definition of a factual requirement, the Subsumption, and the Result.

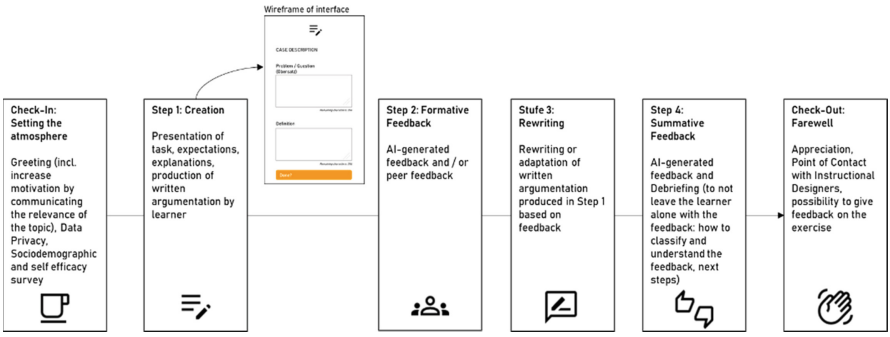

Fig. 2. Argumentation Style Scaffolding Use Case The Argueniser (own visualization)

The aim of any feedback in the use case is to close the gap between a learning objective and the current level of competence. It is intended to generate feedback for the students following the three-perspectives of effective feedback (Hattie 2007, p. 87): Feed-Back, Feed-Up, Feed-Forward. The learning analytics dashboard for the learner might include at a later stage "learning opportunities, self-assessments, recommendations, comparison to peers, social interactions, or additional links (Sahin and Ifenthaler 2021, p. 3). The AI-generated feedback will mainly focus on the Feed-Back perspective through analysis of the content produced by the student. AI evaluation options include, but are not limited to similarity checks in the first stages of the project. One decisive advantage of AI-generated feedback is immediateness: 'Prompt feedback allows students to confirm whether they have understood a topic or not and helps them to become aware of their learning needs. Instant feedback is not only useful for students but also enables teachers to make necessary pedagogical changes in order to address identified gaps in students' understanding.' (Wood 2020, p. 24). Putting this in context with the three basic dimensions of teaching quality, it pays directly into the improvement of student support.

4 Evaluation

The aim is to demonstrate students' competence development in written argumentation through AI-supported learning environments. Consequently, the Hypothesis 1 is: AI-supported ARS learning scenarios with the goal to acquire argumentation skills are more effective than ARS learning scenarios that integrate peer feedback or feedback by lecturer.

Figure 3 illustrates the schematic sequence of the preliminary field study design including repeated measurements. The number of participants per group will be $n > 100$. The study is expected to be conducted in October 2023. Three different treatments are being given, differing in the kind of feedback provided to the student: AI-generated feedback, peer feedback, feedback by lecturer. These three different treatments are being chosen in the current preliminary design as it is assumed that the AI-generated feedback and the feedback given by the lecturer will equalize in quality in the course of the project, while the peer feedback is used as a contrast. The result is demonstrated through the number of those who achieve the required competence. The required competence will be represented numerically. The measuring instrument is the trained correctors. A catalogue of criteria with detailed anchor examples is made available to the correctors.

More hypotheses are being discussed, such as the following:

Hypothesis 2: Sub-aspects of argumentation competence on which the AI can give feedback will develop better than those for which no AI feedback is given.

Hypothesis 3: Those who already show a good result in the baseline measurement achieve a smaller increase in proficiency than those who are rated poor in the baseline measurement.

Hypothesis 4: Students that receive AI-generated feedback in both treatments achieve the greatest increases in proficiency.

Hypothesis 5: Students with a positive self-efficacy expectation will achieve greater increases in proficiency regardless of the scenario.

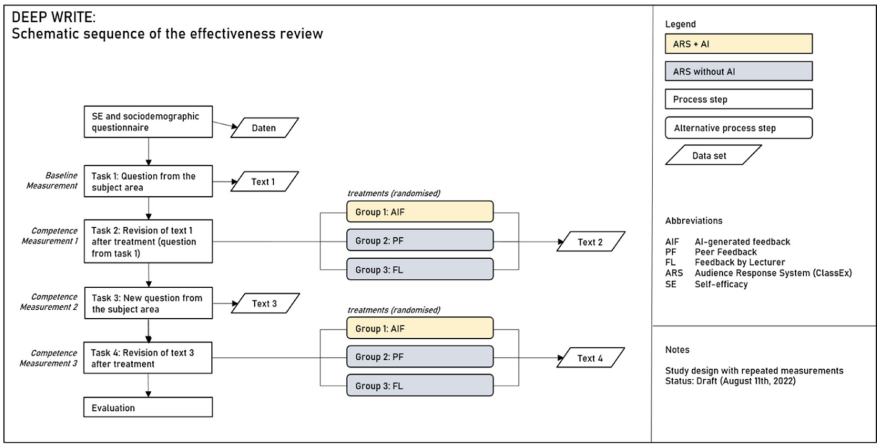

Fig. 3. Preliminary schematic sequence of the effectiveness review

5 Conclusion

As Akata puts it the central question is 'how to build adaptive intelligent systems that augment rather than replace human intelligence' (Akata 2020, p. 20). The use case presented in this paper is an attempt to bring together different perspectives to allow students to develop argumentation skills in a presumably effective AI-supported learning scenario. The study to be conducted in the course of the project will hint at strengths and weaknesses of the concept, giving the chance to improve it further and contributing to augmenting human intelligence.

'Human-centered AI needs [an] integrated approach where technical, social, legal and ethics approaches are used together for supporting the Human-in-the-loop principle.' (Rodríguez-Doncel 2021, p. 2). It is an irrevocable principle in educational sciences to put the learner in the center of the developmental process, rather than in the loop. There has been a discussion within the project whether there should actually be three actors in the center: the learner, the teacher, and the AI, mutually benefitting from each other and evolving together. From the point of view of the authors this question forms a very provocative perspective, nonetheless it might add to the general discourse of AI-development in educational sciences.

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