Adaptive Support for Graphical Argumentation – The LASAD Approach

In the past two decades, approaches to support argumentation learning through graphical representations have gained considerable attention, particularly in collaborative settings (Scheuer et al., 2010). In collaborative graphical argumentation, students create argument diagrams in a shared workspace; boxes represent statements and links represent argumentative or rhetorical relations between statements. The diagrams sometimes capture the argumentative structure of texts given to students, sometimes outline the lines of argumentation to help students prepare the writing of new texts, and sometimes represent structured discussions between students. Many reasons have been cited as to why graphical argument representations are beneficial for learning, e.g., they make argument structures explicit, encourage reflection on basic concepts of argumentation, reduce cognitive load, help systematically explore a space of debate, facilitate the evaluation of arguments, serve as resources and stimuli for discussions, and facilitate automated argument analysis (e.g., Suthers, 2003; Andriessen, 2006; Scheuer et al., 2010).

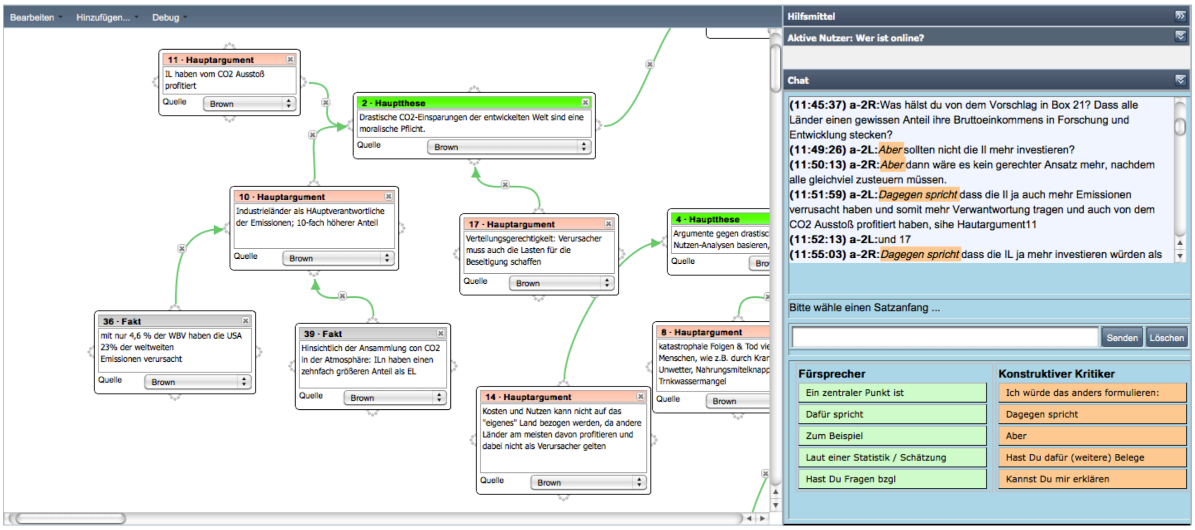

Figure 1: LASAD user interface: argument canvas (left) and sentence opener interface (right)

The LASAD project (Learning to Argue – Generalized Support Across Domains; http://cscwlab.in.tu-clausthal.de/lasad/) is motivated by the observation that graphical argumentation systems typically are not easily adapted to new requirements, since they tend to be tied to specific argumentation domains, visualizations, or collaboration modes. The LASAD system (Loll et al., in press), on the other hand, is a general, cross-domain framework that enables users (i.e., developers, teachers and researchers) to configure workspaces according to their specific requirements. Communication and task-related tools can be added to the workspace such as a text chat, a sentence opener interface, and a text display that allows linking of text passages to elements of the argument diagram. Boxes and links can be configured differently per application; labels, visual appearance, and subcomponents (e.g., text fields, radio buttons and dropdown menus) can be altered. A graphical administration and authoring system has been implemented and integrated with LASAD, allowing users to easily define and administer workspace setups, users and sessions. LASAD is purely web-based; a modern web-browser and web access is all that is required to use the system. Figure 1 shows a screenshot of LASAD.

One of LASAD's key features is its ability to provide adaptive feedback and support to students while they create argument diagrams. A configurable analysis service has been developed, one that receives notifications about user actions, and provides feedback in response. The analysis service uses production rules, specifically the Jess library within Java, to evaluate an evolving argument diagram. With author-specified configuration, the analysis service detects patterns in argument diagrams such as cyclic arguments, boxes that are connected through an incorrect link type, keywords in text fields, or important text passages that have not been considered in the diagram yet. Patterns can also include process characteristics such as actors and timestamps, e.g., to limit the result set to recently created sub-graphs, sub-graphs entirely created by one student or sub-graphs resulting from an interaction between multiple users. This approach builds on previous research that has shown that both structural and temporal characteristics can be important to define meaningful patterns (McLaren et al., 2010, Pinkwart et al. 2009). Feedback strategies are defined in XML files, including feedback text, highlighting of graphical pattern, and pattern priorities. Figure 2 shows a LASAD feedback message (in the window on top of the panel on the right) that has been provided in response to a detected pattern (the box highlighted red).

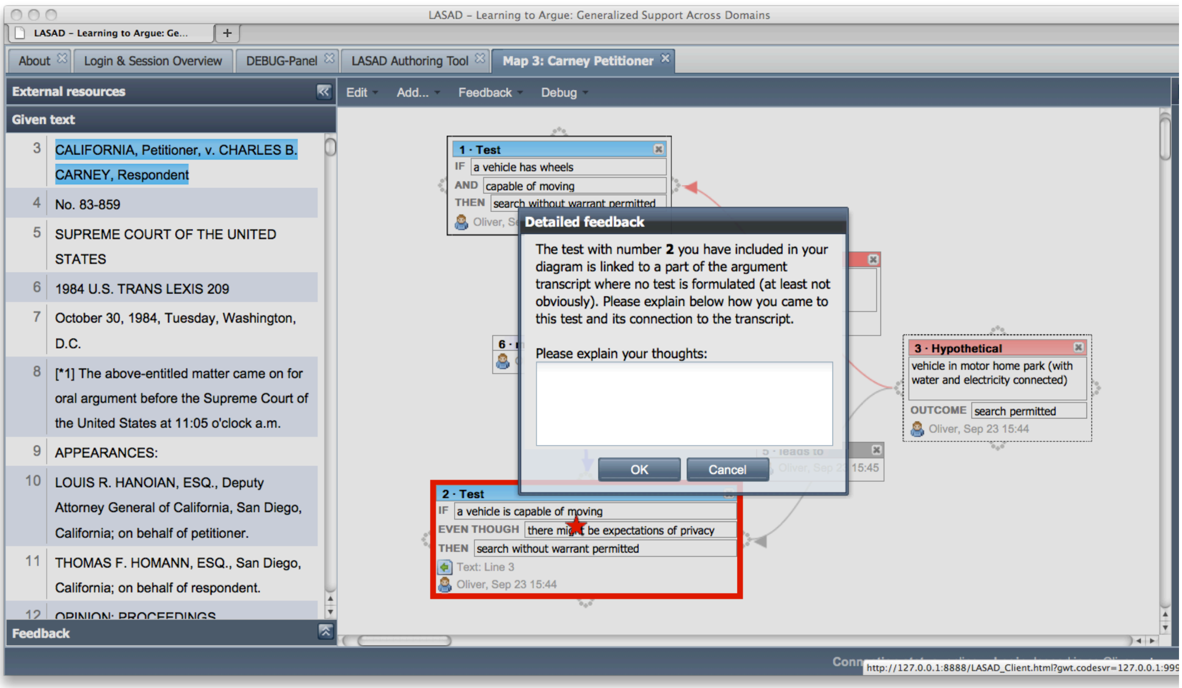

Figure 2: LASAD feedback provision

We are currently developing a graphical authoring tool to support administrators in the definition of patterns and feedback, similar to the way they are already supported in the definition of workspaces, boxes and links. The challenge is to find the right balance between expressiveness and ease of use. We are planning a first version that supports relatively simple patterns. In a second version, we will consider an additional expert mode, in which iterative patterns are also supported (e.g., sequences of undefined length). The general problem of detecting patterns in graphs is known to be NPcomplete ("subgraph isomorphism problem"). It is therefore also important to keep runtime considerations in mind when specifying patterns. We are planning to analyze such complexity issues both from a theoretical and empirical angle, also considering specifics of the Rete pattern matching algorithm used in Jess, to determine boundary conditions for admissible and non-admissible patterns. The goal is to automate the complexity analysis to provide users with feedback regarding expected pattern search times when they define new patterns.

The flexibility of LASAD has been demonstrated through emulations of past systems in different domains such as scientific argumentation (Belvedere; Suthers, 2003), legal argumentation (LARGO; Pinkwart et al., 2009) and e-discussions about socio-scientific issues (ARGUNAUT; McLaren et al., 2010). It has been used in a number of studies to investigate research questions in computer-supported argumentation learning (e.g., Loll & Pinkwart, 2011). The system can be tested online for free (http://homer.in.tu-clausthal.de/lasad/).

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