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Learning to Argue Using Computers – A View from Teachers, Researchers, and System Developers

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Abstract. The ability to argue is essential in many aspects of life, but traditional face-to-face tutoring approaches do not scale up well. A solution for this dilemma may be computer-supported argumentation (CSA). The evaluation of CSA approaches in different domains has led to mixed results. To gain insights into the challenges and future prospects of CSA we conducted a survey among teachers, researchers, and system developers. Our investigation points to optimism regarding the potential success and importance of CSA.

Keywords: Argumentation, Survey, CSCL

1 Introduction

The ability to argue is essential in many aspects of life. However, people often struggle to engage in reasoned arguments [1], making the acquisition of argumentation skills an important educational goal. Classical face-to-face teaching methods are limited due to teacher time and availability. To remedy these limitations, computer-based argumentation systems have been developed. In a detailed review of 50 argumentation systems and methods [2], we recently surveyed the existing approaches. Here, we want to extend this review with a view behind the scenes.

2 A Web-Based Survey: Description & Evaluation

Table 1 contains a set of research questions (RQ) that we are interested in. In this paper, we provide (at least partial) answers to these research questions based on a web-based survey conducted with argumentation researchers, teachers and system developers. Participation was voluntary. The participants were informed about the purpose of the survey and the use of the data. As motivation, we offered the anonymized results of the survey and raffled an iPod among all participants. As part of the survey, participants were asked for their background, including their experience

with research, teaching and designing/developing of argumentation systems (on a 5pt Likert scale) and their primary domain of expertise. Participants were then asked (among others) the questions listed in table 2. Typically, two items were designed to measure the same thing in order to test for consistency. We refer to these pairs as "question" and "control question". Table 2 presents one of each pair.

Table 1. Research questions

No.	Question (Abbreviation)
RQ1	Are visual argument representations helpful for learning and/or understanding argumentation?
RQ2	Can computer-supported / computer-mediated argumentation replace face-to-face argumentation?
RQ3	Does the formality of a domain influence the type of collaboration that is appropriate?
RQ4	Do argumentation researchers, teachers and system developers differ in their views on the suitability of collaboration for argument learning?
RQ5	Is it possible to develop automated analysis features that can effectively analyze arguments and are there any domain-specific differences?
RQ6	When is tutorial feedback most effectively provided?

In total, we received 97 responses. Among them there were 2 participants who self-reported two domains of expertise; thus we counted their responses for both. We excluded all participants with a self-reported experience score below 3 in all domains. To answer the RQs, we calculated means, standard deviations, Spearman-Rho correlations and an ANOVA after filtering "I do not know" responses. For the ANOVA between different argumentation domains, we created an "others" group combining all domains containing only a few, i.e. three or less, participants.

Table 2. Survey questions

No.	Question
Q1	Which answer best describes the type of argumentation that is taught and/or used in your primary domain of interest? (*Scale: 1 = Informal, …, 5 = Formal, 6 = I do not know)*
Q2	In my primary domain of interest, it is important that people learn argumentation through discussions, rather than on their own (e.g., from a book, by sketching arguments on paper, etc).
Q3	In my primary domain weaknesses and errors in arguments can be identified by general and recurring patterns.
Q4	It is possible to assess the quality of an argument just by analyzing general patterns in the argument.
Q5	Arguments shown in graphical fashion are likely to be helpful in learning or understanding argumentation.
Q6	Computer systems have the potential to support people in conducting useful, valid arguments over the Internet, perhaps even improving upon standard, face-to-face discussion.
	Scale for Q2-Q6: 1 = Strongly disagree … 5 = Strongly agree, 6 = I do not know
Q7	Feedback on errors and problems when engaging in argumentation learning is most effectively provided... (*Scale: 1 = Immediately after the error or problem occurs, 2 = After the argument is over, 3 = Only when the participants explicitly ask for feedback, 4 = … (Other), 6 = I do not know)*

To answer RQ1, we used the results of question Q5 (Correlation with control question: ρ=.519 with p=.000 and n=97). The mean results was m=4.24 (sd=.63,

n=97). In particular, there was only one score below 3 in Q5. Thus, there is a strong agreement that visual representations of arguments are indeed helpful for understanding and reflecting upon, and hence learning. There were no significant differences between argumentation domains on this question. Concerning RQ2, our respondents consider computers useful to support argumentation (Q6: m=3.98, sd=.94, n=92), but not to the extent that face-to-face argumentation could be entirely *replaced*, as suggested by the more strongly formulated control question (m=3.28, sd=1.18, n=93). Again, there were no domain-specific differences on this question. Concerning RQ3, formality (Q1) did not correlate with either a preference for an individual or a collaborative argumentation learning approach when considering all domains. However, in the domain "Education" a preference for individual learning was found when argumentation is more formal (ρ=.63, p=.007; n=17). Concerning RQ4, experience with research, teaching and development did not correlate with the participants' views on individual or collaborative argumentation. Regarding RQ5, our experts showed a tendency to believe in the existence of general recurring patterns that indicate errors and weaknesses in their domain of interest (m=3.66, sd=.78, n=87), a tendency that increases with the amount of teaching experience (n=85, ρ=0.23, p=.038), but independent from the concrete domain. RQ6 deals with the question when to react on students' errors and misconceptions. Here, most experts think that feedback is best provided immediately following the error or problem that occurs (n=34). However, nearly the same number of people stated that it is most effectively provided after the argument is over (n=28). A considerable number of experts (n=13) proposed other approaches that mostly depend on the situation. Only few participants (n=3) preferred feedback on request.

In conclusion, there is considerable agreement among the experts that argumentation systems are able to facilitate learning via argument visualization techniques. Additionally, the experts agree that computers have proven their suitability in promoting learning of argumentation. An open issue is the future and application potential of computer-based analysis and feedback on argumentation, especially in less structured argumentation domains.

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