

Effects of Representational Guidance during Computer-Supported Collaborative Learning

Jeroen Janssen, Gijsbert Erkens, Paul A. Kirschner, Gellof Kanselaar, Research Centre Learning in Interaction, Utrecht University, P.O. Box 80140, 3508 TC, Utrecht, The Netherlands
j.j.h.m.janssen@uu.nl, g.erkens@uu.nl, p.a.kirschner@uu.nl, g.kanselaar@uu.nl

Abstract: This research investigated the role of representational guidance during the construction of argumentative diagrams. We used a design that compared two tools that differed with respect to the representational guidance they offered: The Graphical Debate-tool offered more guidance than the Textual Debate-tool. The results show that groups that worked with the Graphical Debate-tool constructed representations of higher quality, wrote better essays, and performed better on a knowledge post-test.

Introduction

External representations (ERs) are graphical or diagrammatic representations that represent information about a topic. The active construction of ERs, is thought to stimulate deeper and more mindful cognitive processing, resulting in larger learning gains (Cox, 1999). These ERs can be constructed individually, or by groups of students. Collaborative construction of ERs may link the benefits of collaborative learning, such as fostering positive social interaction, peer support, and critical discussion, to the benefits of constructing ERs. Unfortunately, this has not always been shown to be the case. Several researchers have reported mixed or even negative results when students collaboratively construct ERs (e.g., Suthers & Hundhausen, 2003).

Representational guidance refers to the fact that different ERs are capable of expressing different information (e.g., cause and effect relationships versus temporal relationships), make different information salient, or stimulate different cognitive processes than other ERs (Suthers & Hundhausen, 2003) and may account for the mixed findings on the benefits of co-constructing ERs. Argumentative diagrams constitute a specific type of ERs. They are usually embedded in computer-supported collaborative learning (CSCL) environments and are used to stimulate students to explicate their claims and arguments. There is evidence that representational guidance influences the effects that argumentative diagrams have on students' reasoning, use and quality of argumentation, and learning (e.g., Schwarz, Neuman, Gil, & Ilya, 2003; Suthers & Hundhausen, 2003). Because most research focused on the argumentative processes students engage in while co-constructing these diagrams, and the quality of the co-constructed diagrams, little is known about the effects that representational guidance may have on individual learning outcomes. The aim of this research is therefore to investigate the role of representational guidance by comparing the effects of two argumentative diagrams that differ with respect to the guidance they offer on the quality of the representations constructed, the quality of the group products (an essay), and students' performance on a knowledge post-test.

Co-constructing a Historical Debate Using the Debate-tool

In this study, students studied the way Christians were treated or maltreated in the Roman Empire. However, there is some debate concerning the magnitude of these persecutions. On the one hand, some historians and the Catholic Church maintain that the persecutions were severe and a great number of Christians became martyrs because they were killed for religious reasons (Martyrs position). On the other hand, there is evidence this number was greatly and deliberately exaggerated by the church and Christians as propaganda meant to inspire Christians and to increase the number of converts (Propaganda position). In this study, the participating students were given a number of historical and contemporary information sources and were asked to analyze and reconstruct this debate by co-constructing a representation of it with a Debate-tool and by collectively writing an argumentative essay based on their findings. In the Debate-tool and the essay students were required to mention and discuss the arguments put forth by proponents of both positions. This required students to process and synthesize the information given in the sources.

Figure 1 shows screenshots of both versions of the Debate-tool. In the left screenshot showing the Graphical Debate-tool, the boxes labeled Martyrs and Propaganda on the edge of the inner circle represent both positions of the debate. While working with the Graphical Debate-tool, students can add arguments (the boxes on the edge of the second circle) to either of the positions. Students can also add information that supports or refutes the added arguments. This is represented by the boxes on the edge of the outer circle. Elements that represent supporting information have a white background, while elements that represent refuting information have a grey background. In the Textual Debate-tool students also add arguments to the corresponding positions. No distinction is made however, between arguments, supports, and refutations. Instead, information is added to

the Textual Debate-tool in two lists. The biggest difference between the Graphical and the Textual Debate-tool concerns the representational guidance they offer. The Graphical Debate-tool uses more visualization techniques to make information salient and to help students complete the representation more effectively and efficiently. The Graphical Debate-tool for example, discerns between arguments, supports, and refutations. This feature may guide students more to search for supporting and refuting information, and to formulate arguments. Furthermore, the Graphical Debate-tool visualizes how well positions are supported by arguments and supporting information. When a position is located closer to the flag, it is better supported by arguments. This may help students to draw a conclusion and thus may contribute to computational offloading (Ainsworth, 1999).

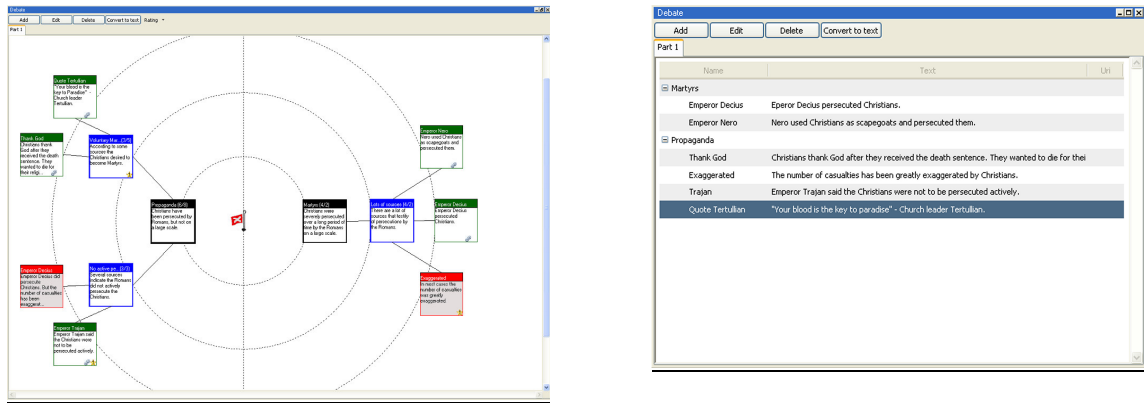


Figure 1: Screenshot of the Graphical Debate-tool (left) and Textual Debate-tool (right).

The Graphical Debate-tool also visualizes students' progress through the problem better. Although both versions give an idea about the balance between both positions (e.g., Has one position been given more attention than the other?) the Graphical Debate-tool makes it clearer whether students tended to focus on certain elements (i.e., arguments, supports, or refutations). Students can infer this from the number and type of boxes that have been added to the representation. In the Graphical Debate-tool students have the option to rate the quality of arguments, supports, and refutations. The rating functionality of the Graphical Debate-tool serves two purposes. It stimulates students to think about and discuss the importance of arguments and may help them to see which arguments are more important than others. Concluding, the Graphical Debate-tool offers more representational guidance than the Textual Debate-tool does. The aim of this study was to examine whether this would lead to better group and individual performance.

Results

We used a single-factor between subjects design (Graphical versus Textual Debate-tool). We randomly assigned three history classes to the Graphical Debate condition (79 students in 24 groups), and two classes to the Textual Debate condition (45 students in 15 groups). We rated all of the items (arguments, supports, and refutations) placed in the tool by the students on a 5-point scale and found that groups in the Graphical Debate condition made representations of significantly higher quality than groups in the Textual Debate condition. We also analyzed the quality of the essays written by the groups. No significant differences were found between the two conditions with respect to number of topics covered in the essays and average conceptual quality of the essays, but average grounds quality was significantly higher in the Graphical Debate condition. Finally, we found that students in the Graphical Debate condition performed better on a knowledge posttest than did students in the Textual Debate condition. The results of this study therefore show the advantage of the Graphical over the Textual Debate-tool and highlight the importance of representational guidance.

References

- Ainsworth, S. (1999). The functions of multiple representations. *Computers & Education, 33*, 131-152.
- Cox, R. (1999). Representation construction, externalised cognition and individual differences. *Learning and Instruction, 9*, 343-363.
- Schwarz, B. B., Neuman, Y., Gil, J., & Ilya, M. (2003). Construction of collective and individual knowledge in argumentative activity. *Journal of the Learning Sciences, 12*, 219-256.
- Suthers, D. D., & Hundhausen, C. D. (2003). An experimental study of the effects of representational guidance on collaborative learning processes. *Journal of the Learning Sciences, 12*, 183-218.

Acknowledgments

This project was funded by NWO, the Netherlands Organisation for Scientific Research (project 411-02-121).