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COMPARING GRAPHICAL AND TEXTUAL PREPARATION TOOLS FOR COLLABORATIVE ARGUMENTATION-BASED LEARNING

Abstract. In our research, part of a European project named SCALE[1], we study the effects of graphical and textual preparation tools on the quality of interaction in computer-supported collaborative argumentation-based learning. Students in upper secondary education had to discuss a topic in pairs, and write a collaborative argumentative text in an electronic environment. This was preceded by an individual phase in which students read information, and represented their individual opinion on the topic either in a text or in a diagram. These individual products were available for inspection during the collaborative phase. We study the way students broaden and deepen the space of debate on this topic.

1. INTRODUCTION

Recently, research focus on collaborative learning has shifted from the effects of collaborative learning to the interaction processes during collaborative learning (Dillenbourg et al., 1996). A crucial process in interaction processes is argumentation (Andriessen & Veerman, 2000). Reasoning about points of view, and supporting arguments may lead to acceptance or rejection of information. Moreover, to be able to express 'good' argumentation, you need to engage in activities that enhance learning, such as looking at information from different sides, and looking for causes and relations to defend certain points of view.

The pedagogical objective of the SCALE project is to create situations for collaborative argumentation-based learning (CABLE) by secondary school students using computer tools. We like students not to acquire factual information, but to co-construct the type of knowledge necessary in a certain space of debate. We want students to collaboratively acquire, refine, and restructure knowledge of a debatable topic (SCALE team, 2002). Students who have constructed this type of knowledge have a *broader* (in terms of different epistemological and societal points of view, with associated arguments) *and deeper* (in terms of related concepts and modes of reasoning) *understanding of the space of debate.*

Our main interest is in the way CABLE can be supported by representational tools. When communicating in a CSCL environment, it is difficult to express the feelings and emotions one would normally express non-verbally, or to point to objects in the environment to refer to something. Some of these problems of CSCL may be remedied by the use of diagrams. It is easy to refer to diagrams, which makes it easier to express one's thoughts (Lohner & Van Joolingen, 2001), and makes them easier to remember (Ainsworth, Bibby & Wood, 1999). Diagrams also make the differences between students' opinions easily visible to them (Baker, in

B. Wasson, S. Ludvigsen, & U. Hoppe (eds.), Designing for Change, 5–9.

press). However, while a diagram can give a visual overview, textual representation concentrates more on details (Larkin and Simon, 1987), and a linear line of thought.

In this paper, we investigate the effects of different forms of preparation tools (i.e., text, diagram, and diagram automatically made from text) on the quality of students' exploration of the space of debate. Our research questions are:

1. To what extent do students collaboratively explore the space of debate in depth and breadth?
2. How are preparation tools used in this exploration of the space of debate?

In comparing the three forms of individual preparation linked to use during subsequent discussion, we hypothesized that students who construct a diagram before discussion will express a broader set of arguments during debate, and will be able to more easily see the 'gaps' in their space of debate, whereas students writing a text individually before discussion will express arguments to a deeper extent in the debate. We predict the best qualitative discussion with 'automated' diagrams, in which students benefit from both text and diagram.

2. METHOD

2.1. Participants and Instruments

Students from five classes in three upper secondary schools in the Netherlands participated (N=142). They were 16 to 17 years old. The experiments were conducted during regular hours in classes of Dutch language, General Sciences, or Biology. The tool we used is TC3, developed at the Department of Educational Sciences in Utrecht to support collaborative argumentative writing in pairs (Jaspers, Erkens & Kanselaar, 2001). Pairs of students, each at their own computer, can communicate by chat, write a collaborative text, construct a diagram, and read information on the task and topic of discussion. In the diagram students can construct an argumentative representation of the topic. There are two kinds of boxes and two kinds of arrows. One box is for representing opinions, the other for representing arguments to support or rebut the opinion. The arrows are green and red, respectively for indicating a positive relation ('in favour') and a negative relation ('against') between boxes.

2.3. Procedure

The task in the SCALE experiment was divided into three phases:

1. Individual debate preparation: Individuals read information on Genetically Modified Organisms (GMOs), and put their opinion, with arguments and counterarguments, *either* in a *text* or a *diagram*.
2. Debate and collaborative writing: Students in pairs discuss the topic of GMOs and *collaboratively write an argumentative text* reflecting their joint opinion. Information is not available anymore, but the individually made *texts, diagrams*, or *a diagram made of a text* of both students are.

3. Individual debate consolidation: students go back to their individual text or diagram and can adjust this product to what they think and know about the topic after debate.

Students were randomly assigned to one of three conditions: one group had to write an individual argumentative text during debate preparation that was available to them during the discussion phase. The second group had to construct a diagram individually during debate preparation, also available during the discussion phase. In a third condition, students wrote a text that was converted into a diagram by the researchers for the collaborative phase.

3. ANALYSES

The program TC3 logs all actions of the two students. Since our focus is on the interaction processes between students in their discussion and collaborative writing, we analyse the logfiles, and not the collaborative text as a finished product.

To order our data and get a general overview, we first analysed the interaction processes with the Rainbow framework[2]. The framework comprises seven principal analytical categories, each represented by a colour of the rainbow: off-task, social relation, interaction management, task management, opinions, arguments, and explore and deepen arguments.

The final three categories constitute the basis for further analyses on the variable 'depth and breadth of the space of debate', used to determine to what extent students explore the space of debate in breadth and depth. To determine breadth of discussion and writing, we performed a content analysis. We distinguished five main topics and fourteen subtopics of the GMOs issue. The depth of the dyad's work is determined by coding all content-related utterances. A coding of 1 is used for stating an argument, 2 for explanations or examples, 4 for supports or rebuttals, and 8 for stating an explicit relation between arguments (Table 1). The individual products are also scored on depth and breadth. Further analysis will be aimed at the *inter*activity in exploring the space of debate, to find out whether students really collaborate in this exploration of the space of debate (see column 'Who' in Table 1).

Table 1. Example of part of protocol scoring on space of debate

Nr	Content of Argument (with topics—breadth)	Who	From where	What happens	Depth
1	Health-nutrients; I am pro, because it is good for the 3rd world, they can use extra vitamins	1	Own diagram	Argument and explanation	1+2
2	Affluence-division; no, 3rd world cannot afford Genetical Modification, it is only meant for the rich West, and then nobody will buy products from the 3rd world anymore.	0	New	Rebuttal, explicit relation and explanation	4+8 +2
3	Affluence-division; but the rich countries will help the poor countries with money and funding.	1	New	Rebuttal and explanation	4+2
4	Af-division; that happens already (funding), but with Genetical Modification nobody will buy things from the 3rd world and they will become even more poor.	0	New	Rebuttal and further explanation of argument #2.	4+2
Tot					29

http://www.springer.com/978-1-4020-1383-6

Designing for Change in Networked Learning Environments

Wasson, B.; Ludvigsen, S.; Hoppe, U. (Eds.)
2003, XX, 536 p., Hardcover
ISBN: 978-1-4020-1383-6