The ‘Talk Factory’ software: scaffolding students’ argumentation around an Interactive Whiteboard in primary school science

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Abstract: Interactions between students can be ineffective when they fail to understand how to talk together and what they should aim to achieve (Dawes, Mercer & Wegerif, 2004). Research suggests that argumentation skills need to be taught explicitly to children and recent work developed students’ collaborative argumentation as a means of improving their understanding of science (Aufschnaiter, Erduran, Osborne & Simon, 2008). Talk Factory is designed to generate graphical representations of the content and processes of students’ collaborative argumentation in real time to assist with these difficulties. We discuss the theoretical underpinning of our work and our participatory design approach.

Introduction
Currently there is a need for software tools that are designed to scaffold students’ engagement in scientific argumentation in the classroom. The aim of the study discussed is to scaffold children’s engagement in the process of scientific argumentation by designing, testing and evaluating software -Talk Factory- that will generate graphical representations of the content and processes of children’s collaborative argumentation in real time.

The discussion in this paper is organised into two sections. In the first section we place our work in the field of existing research and justify its importance. In the second section we discuss our methodology in designing and evaluating the software. In our conclusion we report the issues we will raise in our presentation at the conference.

Argumentation, computer supported collaborative learning and science education
Research has illustrated that argumentation is an important component for the learning of science (Osborne, Erduran & Simon, 2004; Maloney & Simon, 2006; Sampson & Clark, 2008) For example, Osborne et al (2004) noted that students’ engagement in the argumentation process promoted their conceptual understanding in science. However, current research suggests that argumentation is difficult for students (e.g. Dawes et al, 2004), and that little attention is paid to developing children’s argumentation skills (Newton, Driver & Osborne, 1999).

Dawes et al (2004) argue that the talk that takes place in classroom is often uncooperative and off task, and this may be because students lack a clear understanding of the purpose of the activities they are engaged in. They claim that students need to learn first how to listen and talk, before they can engage in argumentation effectively. Based on this assumption they developed an experimental teaching programme for primary school students that focused on the teaching and learning of talking skills. Their results suggest that teaching children how to use talk effectively, and developing their awareness of the importance of this talk during science lessons, increased their understanding of science.

Another field of research focused on using computer supported scaffolds to encourage undergraduates to construct different components of argument. For example, Okada (2008) reports the initial findings of a study that focused on scaffolding young secondary school students’ scientific argumentation with evidence-based dialogue maps, using computer software (Compendium). Initial findings illustrated that dialogue mapping can serve as a new way of scaffolding students’ argumentation

Another approach that has focused on the structuring of discussion is computer-supported collaboration scripts (Stegmann, Weinberger & Fischer, 2007). For example, McAlister, Ravenscroft & Scanlon (2004) designed some online activities involving a mediating interface to be used during synchronous peer discussion, which was evaluated with higher education students in a distance learning context. Learners were required to select from a predefined list of sentence openers such us ‘I think’, ‘I agree because’, ‘why do you say that?’ and then to add their own text to the sentence. Preliminary findings suggested that the argumentation process was more coherent when the statement openers where used compared to the use of a simple unstructured interface.

The tools described above are designed for adults or secondary school students and hence might be unsuitable for primary school students as they are text-based. However, the key dialogue skills that these tools are designed to promote are also very important learning requirements for children developing argumentation skills in Key Stage 2 science (7-11 year olds). Building upon the work of McAlister et al (2004) our work focuses on exploring whether some features of online learning tools can be adapted to scaffold argumentative talk in Key Stage 2 science. Our main focus has been the development of a simple software tool that logs
incidences of key dialogic processes as they occur in students’ arguments, and makes these available to the students graphically, so they can reflect upon the efficacy of their argumentation skills.

**Participatory design of the Talk Factory software**

Four year five classes in a UK primary school (9-10 year olds) and three science teachers participate in the design and evaluation of the software. Based on our reading of the literature (Mercer et al, 1999; Dawes et al 2004), and on our discussions with teachers, we decided upon six positive and negative elements of argumentation to represent (explain reasons; explain disagreements; ask others; not giving reasons; interrupt; not paying attention). These elements were considered by the teachers to be the most relevant to incorporate in a scientific argument, and they represent features of argumentation as defined by Maloney and Simon (2006). The processes of argumentation are represented in the Talk Factory as six talk rules. In addition sentence openers are displayed, to guide students’ understanding of how to begin dialogic responses that follow these rules (Figure 1).

The software requires the teacher to tap (on the IWB) on each rule as a child makes an utterance, and the software transforms the teacher’s input into a bar graph quantifying the occurrence of key argumentation processes, so as to make the data available to the students and the teacher. The horizontal bar represents the sequence of events. In addition a summed number is given for both desirable events (‘happy face’) and undesirable events (‘sad face’). The teacher can use these numbers to help the students to improve their metacognitive awareness of, and hence engagement in, the process of class argumentation. Students’ understanding of bar graphs was assessed before deciding to use these to represent argumentation processes. The ‘rules’ diagram and the graphs in Figure 1 illustrate the core features of the Talk Factory. Additional features vary according to the context of the task and include providing each student/group within a class, with their own screen space in which to represent their own current understanding of a task. The software is designed based on a hypothesis testing approach (Howe and Tolmie, 2003). This approach involves deploying a series of tasks where pupils firstly debate their knowledge to reach a consensus about the hypothesis to be investigated, secondly design practical controlled investigation of their hypothesis, thirdly perform the investigation, and finally, discuss the outcomes together.

The second phase of software development has focused on the iterative learner-centered design and testing of paper prototypes in a pilot class with a group of children. During this phase paper-based software prototypes were evaluated by children in terms of their usability. Also, the researchers met the teachers and demonstrated prototypes and audio-recorded the teachers’ feedback, which was incorporated into subsequent versions of the software prototypes. In addition, the same class participated in piloting the first version of the software and students’ feedback was implemented in further iterations.

Finally, the third phase has focused on the evaluation of the software and involved two intervention classes and a control class. This phase included the following stages of data collection:

(a) videos of pre-software lessons of the intervention classes;
(b) pre-test to assess students’ argumentation skills and domain knowledge;
(c) two introductory lessons where students produced the set of talk rules presented in Figure 1.
(d) following the ‘talk’ lessons, children in the intervention classes took part in a series of science lessons using the software, and children in the control class took part in the same lessons using a version of the software that does not include any scaffolding features.
(e) post-testing to identify any changes in students’ argumentation skills and domain knowledge.
Data Analysis
We are adopting both quantitative and qualitative methods to compare the occurrence of content (e.g. key words such as ‘because’, ‘I think’ and process (e.g. claiming, justifying) of argumentation events between the intervention and control classes. Firstly, this includes a comparative quantitative analysis of content events. The occurrence of content events is being coded using NVivo. The number of occurrences of each key word is statistically compared, across control and intervention classes using SPSS. Secondly, the process events in the intervention and control classes will be coded and counted using NVivo. The analysis of argumentation processes is concentrated on the extent to which students in the two groups have engaged in claiming, justifying, and opposing the arguments of each other. We are using elements of the framework developed by Maloney and Simon (2006) to code the process events. The numbers of occurrences of each coded event will then be statistically compared across the two groups using SPSS. These data are supplemented by qualitative analysis of video footage of the control and intervention classes. The focus of this analysis is on identifying how the software features or lack of them, and the affordances of the IWB mediate the content and process events. In addition, quantitative analysis of pre and post testing, using SPSS, is conducted to assess the software’s effectiveness in improving students’ argumentation skills and domain knowledge.

Conclusion
In this paper we have described the theoretical underpinning of our work and some of the features of the Talk Factory. A key aim of our work is to develop a new theoretical understanding of how graphical representations of the content and processes of argumentation might be effective in scaffolding learner argumentation and improving domain knowledge in Key Stage 2 science. In our study two tools are involved, the software and the IWB. In our presentation we hope to demonstrate further how these tools can mediate students’ scientific argumentation, and promote their understanding of science. We will report in detail on findings about whether the Talk Factory can improve students’ argumentation by developing their awareness of language use. In particular, our focus will be on the differences between the use of the software including the scaffolding features described above, and a version that does not include any scaffolding features. In addition, we will demonstrate the use of the software and highlight successful ways in which teachers used the software to engage their students in argumentation. Implications for teaching and future research will be discussed in the light of these findings.

References