PhysHint: A Qualitative Study of Student's Knowledge Elaboration in CSCL

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Abstract: The poster concerns a qualitative study of student's knowledge elaboration in computer-supported collaborative problem solving. The aim of the study is to investigate whether we can use elaboration value as a measurement to insight into student's communicative artefacts in CSCL and diagnose the crux of mixed-gender collaboration.
Keywords: CSCL, problem solving, physics learning, partner gender

Introduction

Parnter gender plays an important role in dyadic collaboration, especially for high school female students in solving physics problems (Ding & Harskamp, 2006). Although mixed-gender collaboration produces more ideas and a greater diversity of proposals than single-gender collaboration (van Hiel & Schittekatte, 1998), females are at a disadvantage with respect to learning achievement (Graham, Fenwick and Derrick, 2001). In our previous research (Ding & Harskamp, 2006; Harskamp & Ding, 2006), we used Bales' Interaction Process Analysis (IPA) model to investigate students' information exchange during collaboration, and found that the presence of male students made females reluctant to put forward ideas and become less active in collaboration. But partner gender has no significant influence on males' interaction. Students have different exposure to the use of computer technology. The computer itself is arguably a disadvantage for females because computer-mediated communication (CMC) is historically stereotyped as a male dominated domain.

Although numerous research has investigated females'communication styles in single- and mixed-gender collaboration, very few research affords an insight into students' knowledge elaboration, especially in the field of Computer-Supported Collaborative Learning (CSCL). According to Sutherland (2002), elaboration of knowledge is the key factor for students' problem-solving learning. Therefore, we embark this qualitative study to verify whether we can use message elaboration as a measurement to insight into students' cognitive activities in CSCL and diagnose the crux of mixed-gender collaboration.

Knowledge Elaboration in CSCL

In collaborative problem solving, group is the learning agent (Suthers, 2006). The joint knowledge elaboration is made up of numerous meaningful artefacts, such as utterances, visual representations. Students learn more from each other through elaborative explanations than simple forms of exchanges (Webb & Farivar, 1999; van der Meijden & Veenman, 2005). The knowledge elaboration perspective which emphasizes the cognitive process of collaborating individuals states that learning occurs when students are involved in reflecting, correcting, extending and restructuring partner's way of thinking (King, 1999; Webb & Farivar, 1999; van der Meijden & Veenman, 2005). The knowledge elaboration might differ across participants. We presume that the individual difference in knowledge elaboration could be reflected by the content of individual communicative artefact. Looking into students' communicative artefacts, we might deduce whether they are elaborating their knowledge and what kind of relationship exists between the collaborating individuals' elaboration process.

CSCL can make students' ideas visible and preserve them in a shared context. Firstly, it is regarded as a way to deepen students' talk and turn their transitory talk into visible artefacts for reflection; Secondly, in CMC, as Rutter (1987, p.74) states that "cuelessness leads to psychological distance, psychological distance leads to task-oriented and depersonalized content, and task-oriented depersonalized content leads in turn to a deliberate, unspontaneous style and particular types of outcomes." However, it is also argued that the reduced shared context is expected to have reduced utility (Suthers, 2006) because the shared context represents the multiple facets that make up the participants' identity, which facilitates the negotiation of interpersonal questions.

Problem-solving task is a goal-oriented task. Students communicate with each other in order to accomplish a set of goals and sub-goals. Thus, a communicative artefact is not merely a simple expression of students' knowledge or understanding, but connected with each other to construct a meaning jointly. While analyzing, we should relate it to the context of joint knowledge elaboration. If we define the first artefact which students exchange as the initial state and the subsequent one as meaningfully interrelated, we might plot the track of the joint and individual elaborations in a sequential analysis.

Research Question

Focusing on students' online communicative artefacts, is it possible to use elaboration values as a measurement to find differences of knowledge elaboration between single- and mixed-gender collaboration in CSCL?

Methodology

The computer program "PhysHint" aims at improving secondary students' problem-solving skills in physics. It was compiled with SQL to facilitate an online collaboration in physics problem solving. For instance, a dyad of students work together on a moderately-structured physics problem synchronously. They can communicate in the *Chatting Section* and illustrate the variables in the *Drawing Section*. What student A draws is automatically shown on student B's computer. To strengthen and structure students' interaction, we provide five "*Hints*" for problem solving. Different students read different hints so that they have to exchange what they read. In the end, they input their answers in the *Answer Section* for an evaluation by the computer. After that they are given the *Worked-out Example* to check the details.

Six secondary school students (3 girls & 3 boys) participated in the five-day experiment. There were three dyads: one mixed-gender dyad and two single-gender dyads. Prior to the experiment, they were given a twenty-minute pre-flight training about how to use the program. Then they were separated with a board to avoid talk or eye-contact with each other. The whole experiment was overseen by the researchers. We endow each communicative message an elaboration value according to its content (Table 1):

Table 1: Sample of Elaboration Values.

Number	Description	Example
+1	messages elaborating on knowledge and contributing to the final solution.	Student A: What is the Newton's 2nd law? Student B: F=m*a
0	messages remaining on the previous elaboration level	*(Student B: F=m*a)* Student A: Yeah.
-1	messages that are irrelevant to the task and distract the problem solving task	Student B: You will go to Rome, won't you?

Results

Peter & Henry (male-male dyad)	Sandy & Karol (female-female dyad)	Ralf & Jenny (mixed-gender dyad)

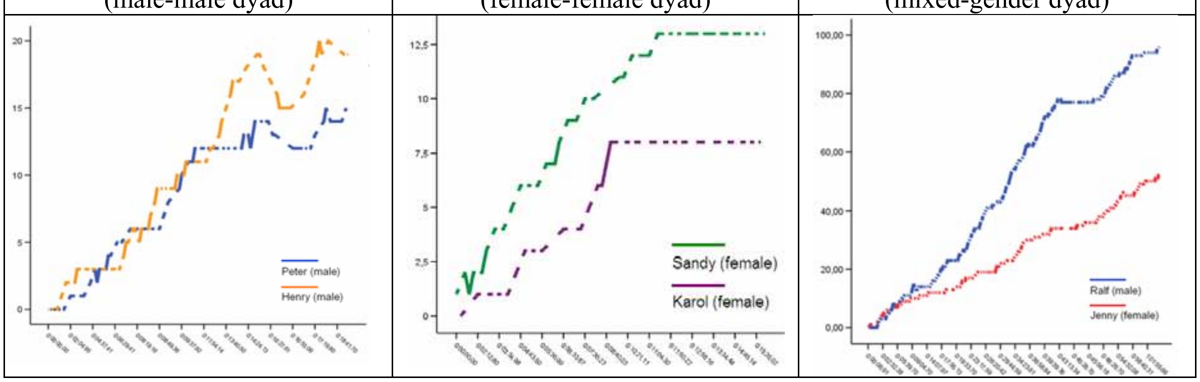

Figure 1. Individual Knowledge Elaboration in 3 dyads (*students are pseudonymous*)

As we add up students' individual elaboration values and plot them sequentially, we are able to illustrate the process of knowledge elaboration in each dyad (Figure 1). Three dyads exemplify three types of relationship of individual knowledge elaboration: *Cross* (in Peter& Henry dyad), *Parallel* (in Sandy & Karol dyad) and *Divergent* Elaboration (in Ralf & Jenny dyad). We look into the mixed-gender dyad and zoom in the episode that Ralf and

Jenny diverge in knowledge elaboration. After examining their communicative artefacts, we find two problems that lead to the divergent knowledge elaboration: incoherence in CMC and Ralf's overlook of questions.

Discussion

The study shows that the elaboration value can be a workable measurement to trace students' cognitive activities in CSCL and diagnose the problems in dyadic collaboration. In the future, a quantitative study involving more students and a longer period of experimental time are expected.

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