Methods of analysis for identifying patterns of problem solving processes in a computer-supported collaborative environment

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Abstract: Recently, there have been calls to undertake further analysis of learner interactions in collaborative computer supported environments that move beyond code and count. We present three different means of analyzing and interpreting conversational data recorded from learners sharing a computer to solve a virtual inquiry. We propose that through the use of group function analysis, discourse analysis and an analysis of periodicity we can gain an understanding of how learners interact on both macro and micro levels.

Introduction
Reporting on multiple measures of process is becoming more common (see for example (Evans, Feenstra, Ryon, & McNeill, 2011; Weinberger & Fischer, 2006)). An advantage of the use of multiple measures is the ability to report on interaction effects (Weinberger & Fischer, 2006) and relationships between data at different levels, particularly individual contributions to group processes (Ding, 2009). We describe our experiences capturing and analyzing student learning patterns as we reinterpret the data through the administration of different coding systems and visual representations. To understand the successes and failures of learning in a virtual world, learning processes need to be understood in addition to relationships to learning outcomes. We recorded the in world actions of four postgraduate and eight undergraduate education students in their interactions with a narrative-based virtual world, Virtual Singapura. The results are not presented in full; we demonstrate the results of the different treatments through the analysis of excerpts from two dyads.

A Group Functions Perspective
One question to be answered by this study was to ascertain if there were patterns in the collaborative problem solving that may indicate a successful problem solving strategy. The rationale for this is that if successful strategies can be identified then scaffolding can be incorporated into the learning activities – this may be in the form of teacher instruction, prompts, discussion and work sheets, for example. A modified version of the DFCS from Poole & Holmes (1995) was adopted for the analysis of the collaborative problem solving (Figure 1).

The opportunity to relate the synchronous collaboration data to the information about the interaction with the virtual world provided insights into the design and scaffolding required in this inquiry-learning task. However, coordinated analysis of data was time-consuming, and would benefit from some element of automation. Moreover, the use of a code and count approach has been deemed to lack the necessary rigor to provide a detailed understanding of how a group functions (Kapur, 2011).

A Systemic Functional Linguistics Perspective
We hypothesized that we could obtain a better understanding of the different ways in which dyads react to the degree of structure in a virtual world if a systemic functional linguistics approach to the analysis was applied. The data were coded using Collaborative Process Analysis Coding Scheme (CPACS) (Kennedy-Clark & Thompson, submitted). We identified patterns in each of the multiple code categories: action, content, attitude, tense, modality and pronouns. Within the content category, patterns ranged from simple navigation (Dyad 1) to a more cyclic process: plan, navigate, collect data (Dyad 6).

**Visualizations of Periodicity**

Periodicity is temporally constrained and shows the development or non development of waves of conversation across a temporal axis. After coding the data using CPACS, we were able to present a visual pattern of the waves of conversation. Figure 3 demonstrate the periodicity of the content code in Dyads 1 and 6.

![Visualizations of Periodicity](image)

(a) Dyad 1  
(b) Dyad 6

**Figure 2. Periodicity of content code**

**Conclusions**

The results suggest that helping students to develop routines for problem solving would be more effective that not developing routines. What is missing in this discussion is any mention of the temporal nature of the data, and the ways in which the groups’ processes change over time, or with regards to the context of their learning. Visualisations were found to be useful in identifying areas of overlap and the multiple reasons for a group’s success.

**References**


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