MODELING LEARNER-TO-LEARNER INTERACTION PROCESS IN COLLABORATIVE LEARNING

An Ontological Approach to Interaction Analysis

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Abstract: In this poster, we introduce an example of interaction patterns which are models of desired interaction process inspired with learning theories and vocabulary to represent the models. To evaluate collaborative learning session itself and/or educational benefits for learners, we should analyze interaction process, and capture what actually happens in the session. However, the interaction process is too complex to analyze for novice teachers or system designers. One of major causes of the difficulty is the lack of models and vocabulary to represent the process. So, we propose the vocabulary and the models of the interaction process described by the vocabulary.

1. INTRODUCTION

To evaluate collaborative learning (CL) session itself and educational benefits for each learner gets through CL session, we should analyze interaction process among learners, and capture what actually happens in the session. The key to understanding CSCL lies in understanding the rich interaction between individuals (Dillenbourg, 1999). So, interaction analysis has been attracting attention of many researchers (Barros & Verdejo, 2000; Katz, et al., 2000; Muhlenbrock & Hoppe, 1999; Okamoto, et al., 1995; Soller, 2001). However, the interaction process among learners is too complex and it is difficult for novice teachers or designers to analyze it. One of the major causes of the difficulty is the lack of models and vocabulary to represent the interaction process. As a solution to this problem, we have been adopting Ontological engineering technique to establish shared understanding about the model of CL (Inaba, et al., 2000a; Inaba, et al., 2000b; Inaba, et al., 2001; Inaba, et al., 2002; Supnithi, et al., 1999). At present, we rely on learning theories as justification of learning design. By the ontology, we want to represent and store designs, and the ontology will facilitate users' design and analysis of CL session by referring to the patterns as design rationales. In this poster, we concentrate verbal interaction among learners and propose two kinds of vocabularies to represent interaction process among learners: utterance-labels and utterance-types, and then, we introduce interaction pattern which is a model of interaction process.

2. TWO TYPES OF VOCABULARIRES TO REPRESENT INTERACTION PROCESS

We prepare two kinds of vocabularies to represent interaction process: utterance-LABELS and utterance-TYPES. To ease labeling to each utterance, we need vocabulary at a concrete level. On the other hand, to ease characterizing learning sessions, we need vocabulary at an abstract level. We satisfy these contradictory requirements by clustering vocabulary. There are different types of CL sessions. Every educational benefit that participants get through CL has its own desired interaction process. So, we need to prepare an appropriate set of utterance-labels which can represent the various kinds of CL processes and be distinguishable the differences among each kind of the interaction process. First, we collect the prototype set of the utterance-labels, and then, enrich it through labeling process to actual protocol data. To enrich a variety of CL that can be represented with the utterance-labels, we collect protocol data based on multiple learning theories. The prototype set of the utterance-labels is refined by investigation. We uploaded the protocol data during CL on the web, and ask CSCL researchers and educational practitioners of labeling each protocol by one of the utterance-labels. If there is no appropriate label, the users can define new

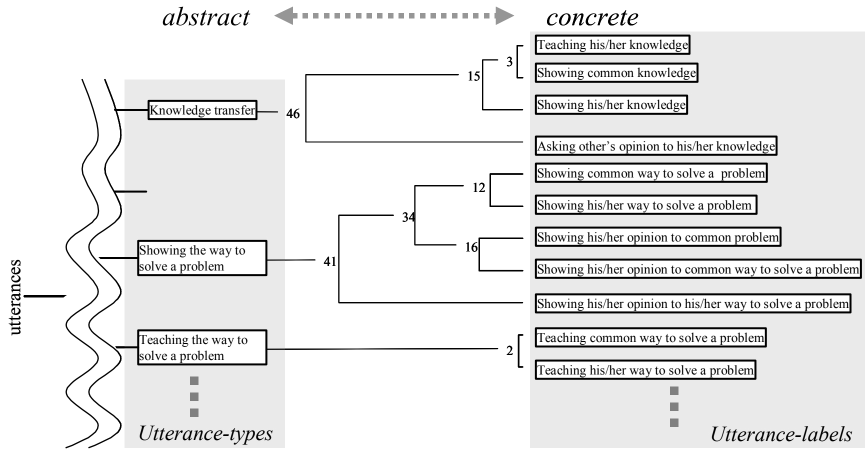

Figure 1. A part of the dendrogram as a result of the cluster analysis

labels. As the result, we omitted some ambiguous labels and some labels which are not used. Then, we clusterize the utterance-labels with hierarchical cluster analysis method (furthest neighbor method). To avoid that similarity of the labels depends on frequency of usage of the labels, we standardize the absolute value of vectors to calculate the distance. Figure 1 shows a part of the dendrogram as a result of the analysis. Using the hierarchical cluster analysis method, cases with high similarity are adjacent. By clusterizing the utterance-labels, we can abstract interaction process at an arbitrary level as the need arises, while we keep usability of the utterance-labels to tag each protocol datum. If the set of utterance-labels often change depending on the purpose of analysis, for example, users are required to tag protocol data again with another set of utterance-labels whenever the users want to know something new, the users feel difficulty to use them, and it is very complex and time-consuming. We clusterize the vocabulary once, and then provide the vocabulary at the most concrete level of the cluster to tag raw protocol data for users; we use the vocabulary at an abstract level of the cluster to characterize interaction processes. We call the vocabulary at an abstract level is utterance-types. The level of abstraction should be defined to distinguish and characterize each type of CL session by the utterance-types.

3. MODEL OF INTERACTION PROCESS

To construct interaction patterns, first, we represent the interaction processes as sequences of utterance-labels based on the data from investigation, and convert the utterance-labels into more abstract utterance-types. Then, we get sequences of utterance-types which represent seven types of interaction processes in theory-based CL. Next, we extract distinctive interaction processes from the each sequence; for example, the process in which most users who labeled the protocol data use similar utterance-labels, the process which is frequently observed in the session, or the process which represents the characteristics of the session well. Figure 2 shows an interaction pattern in Cognitive apprenticeship type CL (Collins, 1991) as an example of the interaction patterns. As the figure shows, an interaction pattern is represented as utterance-types (represented as nodes) and possible transitions (represented as arrows) among the utterance-types. There will be four types of transitions among the utterance-types: desired transitions, necessary transitions, wrong transitions, and the others. At present, we construct interaction patterns to represent the necessary transitions and desired transitions, and in future, the interaction pattern will also represent wrong transitions among the utterance-types for a specific learning goal.

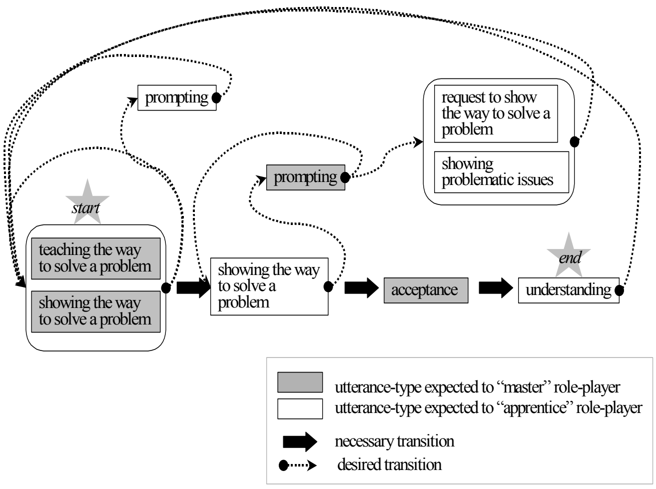

Figure2. An example of interaction pattern: cognitive apprenticeship

5. CONCLUSION

We described the need to have models and vocabulary to represent learner-to-learner interaction process during CL. We proposed two types of vocabulary to represent learners' raw protocol data and characterize the learning session. And then we also introduced interaction patterns which are models of desired interaction process inspired by learning theories. To represent typical interaction process explicitly like this, it becomes possible to compare an actual interaction process with a typical interaction process, and help users estimate educational benefits for the learners.

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