CHOCOLATO: A Concrete and Helpful Ontology-Aware Collaborative Learning Authoring Tool

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1 Introduction

To develop intelligent systems to support collaborative learning (CL) is especially challenging in view of knowledge representation. Current knowledge concerning CL is based on various learning theories, which are always expressed in natural language and are particularly complex given the context of group learning where the synergy among learner's interactions affect the learning processes and hence the learning outcomes. Without the explicit representation of learning theories it is difficult to support the design of group activities based on well-grounded theoretical knowledge. Our approach calls upon techniques of ontological engineering to make theories "*understandable*" both by computers and humans. We then propose techniques to reason on these theories to develop an intelligent support system that supports group formation, facilitates the design of CL activities, and minimizes the load of interaction analysis. This system is referred to as **CHOCOLATO**: A **C**oncrete and **H**elpful **O**ntology-aware **C**ollaborative **L**earning **A**uthoring **To**ol. In this demonstration we will present one of its sub-systems called **MARI** – *Main Adaptive Representation Interface* that represents theories graphically to facilitate the design CL activities with theoretical justifications.

2 Hardware/Software Requirements

The minimum requirements to run our system are:

- Any operational system that support Java (JVM);
- Java Standard Edition, version 1.5 or higher;
- CPU: Pentium 800MHz or similar;
- Memory: 256Mb;

3 Technical Content

To support group activities there are many learning theories (such as Anchored Instruction, Peer Tutoring, LPP, etc). Thus, to assign roles and strategies for learners in a group we can select appropriate set of learning theories considering necessary pre-conditions and desired educational benefits for learners. This flexibility of choosing different learning theories provides us with many ways to design and conduct learning processes. However, it also suggests the difficulty of selecting the appropriate set of learning theories during the instructional design to ensure learners' benefits and the consistency of learning processes. Therefore, to help users (instructors, teachers, designers, etc) to design effective group activities we need an elaborated system that considers different learning theories to support the design in compliance with them.

To support the design of CL activities MARI has been implemented in Java and use ontologies built using the Hozo ontology editor (http://www.hozo.jp/) to interpret learning theories and their features. It currently has 6 theories and 12 strategies, besides other information in its database. Using ontologies MARI can reason on the theories to select appropriate learning theories and to suggest consistent sequence of activities for learners in a group. The **suggestions** given by our system are only guidelines for users to propose CL activities based on theories which: (a) preserves the consistency of the learning process; and (b) guarantees a suitable path to achieve desired benefits.

To represent learning theories graphically, MARI uses the **GMIP**- *Growth Model Improved by Interaction Patterns* [2]. The GMIP is a graph model based on an ontological structure to describe an excerpt of learning theory. It represents, in a simplified way, the learner's knowledge acquisition process and skill development process in compliance with [1] and [3]. The GMIP graph has twenty nodes, which represent the levels of the learner's development at a certain moment of learning. Each node is composed by two triangles. The upper-right triangle represents the stage of knowledge acquisition, while the lower-left triangle represents the stage of skill development. The nodes are linked with arrows that show possible transitions between nodes.

MARI starts with a neutral network that can represent any theory we analyzed. For example, in Figure 1 we show the theories: Cognitive Apprenticeship (using the strategy learning by apprenticeship), Peer Tutoring (using the strategy learning by teaching), Distributed Cognition (using the strategy learning by discussion) and Anchored Instruction (using the strategy learning by diagnosing). Each of these theories requires different pre-conditions and describes different goals to be achieved. In the case of Peer Tutoring, a learner who follows the strategy learning by teaching (and plays the role of tutor) needs, as a pre-condition, the knowledge about a specific content in accretion stage (half-filled upper-right triangles), but does not necessary need skills about how to use it. In such situation, the main goal of the tutor is to acquire knowledge in tuning stage (full-filled upper-right triangles).

In MARI, by clicking in the bold arrows the system can suggest CL activities (interactions) prescribed by the selected theory which help learners in one stage to achieve the next stage. For example, using the theory Cognitive Apprenticeship and the strategy learning by apprenticeship, MARI shows in Figure 1 the necessary and complementary interactions as full boxes and dashed boxes, respectively (bottom-right of Figure 1). Finally when the user click in one bold arrow in the GMIP path (top-right of Figure 1), it shows which interactions are associates with this arrow (transition of stages).

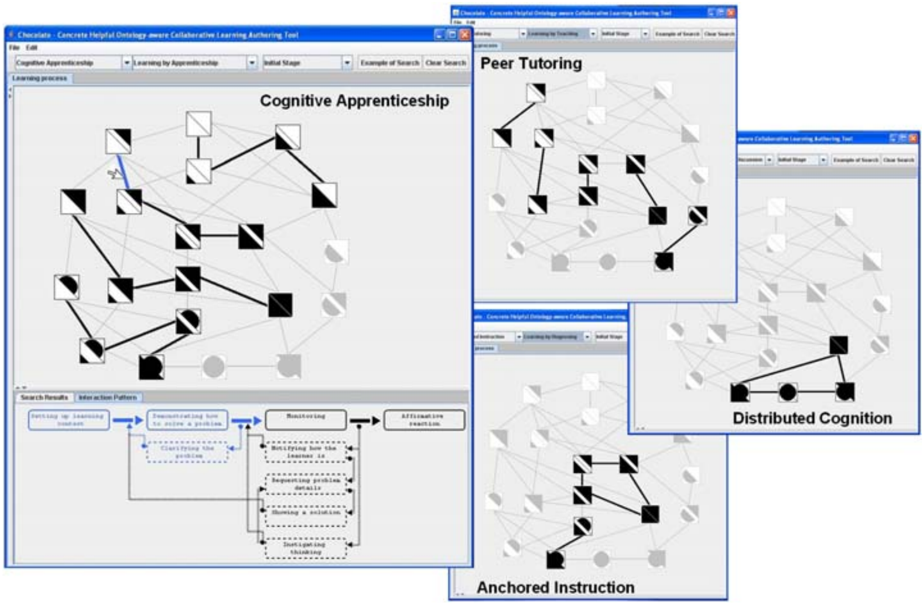

Figure 1. MARI interface: graphical visualization of different learning theories.

Another useful function in MARI is to search theories by given a stage of learner's development. We can select an initial stage of a learner in the GMIP and the system will reason on the ontologies to search for any theory/strategy that has the selected stage in the beginning of the path. As same as before we can select a final stage and the system will search for any theory/strategy that has the selected stage in the end of the path. And finally, the system can search for any theory/strategy that has a path through the selected stage (it means any stage in the path). All these ways of search can be combined, thus, users can select, for example, an initial stage (pre-conditions) and a final stage (expected benefits) of a learner and the system will find the theories/strategies that help this learner to achieve the desired benefits. If more than one theory/strategy is found, users can select one of them and the system suggests activities in compliance with it.

In this demonstration we will show how to use the functionalities presented above and, possibly, new functionalities that are under development.

References

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