Learning Goals and Design Rationales in Collaborative Learning

An Ontological Approach to Support Design of Collaborative Learning

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Many of software designers of Computer Supported Collaborative Learning (CSCL) environment have been suffering with complex and subtle educational requirements offered by clients. One of major causes of the problem they face is the lack of shared understanding of collaborative learning. We do not know what design rationale of CSCL environment is and even do not have common vocabulary to describe what the collaborative learning is.

In this research we are aiming at supporting such complex instructional design process of CSCL environment. To fulfill the aim we have been constructing an ontology to represent CSCL session. Advantages of collaborative learning over individual learning are investigated in different research areas: Social psychology, Pedagogy, Sociology, Educational psychology, Cognitive Science and so on. We call these research findings "Learning Theories". The learning theories seem to be useful as the design rationales of CSCL sessions; however, it is difficult to understand them for persons who are not experts in the domain. Due to the diversity of the research area, no one can understand all theories and apply them appropriately. So, we have built Collaborative Learning Ontology and formulated CSCL models in terms of the ontology. [6, 7, 8, 9, 16] With the ontology, we can represent many kinds of CSCL sessions in terms of common vocabulary. We adopt learning theories as foundation to represent, analyze, design, and develop the learning sessions. In this poster, we show some vocabulary and design patterns concerned with learning goals and learning groups based on our Collaborative Learning Ontology. We have extracted common features of phenomena, which are development of learning community, interaction among learners and educational benefits for a learner, from the learning theories. The learning theories account for such phenomena, and a designer or a learner can regard the phenomena as goals. So, we use the term "learning goal" to represent such phenomena. Namely, we call the goal of development of learning community **W(L)-goal**, the goal of group's activity **W(A)-goal**, the goal of interaction among learners **Y<=I-goal**, and the goal of educational benefits for a learner **I-goal**.

I-goal: personal developing goal. It represents what a learner is expected to acquire. It can be described as a change of a learner's knowledge/ cognitive state.

Y<=I-goal: personal interaction goal. It represents what a learner is expected to acquire through the interaction. The interaction also can be regarded as means to attain an **I-goal**. It can be described as increase of a learner's experience.

W(L)-goal: group's development and learning goal. It is a common goal for members of the group.

W(A)-goal: group's activity goal. It is a common goal characterizing the whole group.

Fig.1 represents learning goals in a group where three learners: L_A, L_B and L_C are participating. Learner L_A has an I-goal that is attained through this collaborative learning session and this goal is described in Fig.1 as **I-goal** (L_A). Both L_B and L_C also have I-goals, and they are represented as **I-goal** (L_B) and **I-goal** (L_C) respectively. **Y<=I-goal** (L_B<=L_A) is a Y<=I-goal between L_A and L_B observed from L_A 's viewpoint. In other words, it means the reason why L_A interacts with L_B. Concerning this interaction between L_A and L_B, there is also a Y<=I-goal observed from L_B 's viewpoint. That is, it is the reason why L_B interacts with L_A. This Y<=I-goal is represented as **Y<=I-goal** (L_A<=L_B). Both **I-goal** (L_A) and **Y<=I-goal** (L_B<=L_A) are personal goals of L_A. Both **W(L)-goal** ({ L_A, L_B }) and **W(A)-goal** ({ L_A, L_B }) are goals of the learning group ({ L_A, L_B }). Similarly, **W(L)-goal** ({ L_A, L_B, L_C }) and **W(A)-goal** ({ L_A, L_B, L_C }) are goals of the learning group ({ L_A, L_B, L_C }).

We have identified goals for collaborative learning for each of the four categories with justification based on learning theories. We have identified four kinds of **I-goal**s and three phases for each of them, such as 'acquisition of content-specific knowledge (phase: accretion, tuning, restructuring)'[14], 'development of cognitive skill (phase: cognitive stage, associative stage, autonomous stage)[1, 5], and so on. The learner is expected to achieve these **I-goal**s through interaction with other learners. We have pick up ten kinds of **Y<=I-goal**s, such as 'learning by teaching', 'learning by observation'[2], 'learning by self-expression'[17], and so on. The examples of **W(L)-goal**s are 'knowledge sharing'[15], 'creating a solution'[13], 'spread of skills'[3, 10] and so on. The **W(A)-goal**s mean activities accomplished by learning groups; for example, the learning activity where a new comer to the community learns something by his/her own practice, mentioned in the theory of LPP[10], the learning activity where a knowledgeable learner teaches something to a poor learner, mentioned in the theory of Peer Tutoring[4]. Each **W(A)-goal** provides the rationale justified by specific learning theory. That is, the **W(A)-goal** specifies a rational arrangement of learning goals and a group formation. Fig.2 shows a typical representation for the structure of a **W(A)-goal**. The **W(A)-goal** consists of six concepts: **Common goal**, **Primary Focus**, **Secondary Focus**, **S<=P-goal**, **P<=S-goal**, and **Learning Group**. The **Common Goal** is a goal of the whole group, and the entity of the **Common goal** refers to the concepts defined as **W(L)-goal** ontology. Both **Primary Focus** and **Secondary Focus** are learners' roles in

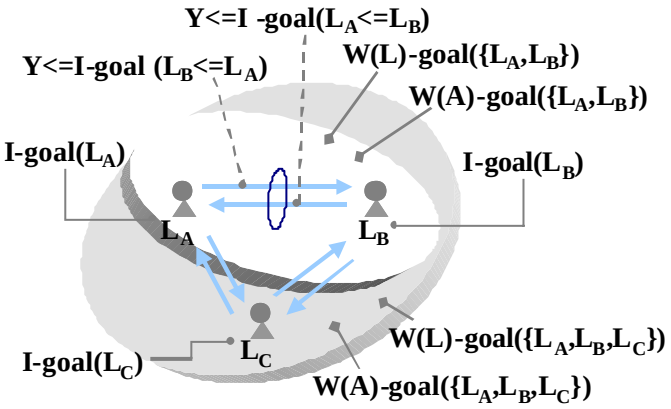

Fig.1 Learning Goals in a Collaborative Learning Session

a learning group. A learning theory generally argues the process that learners, who play a specific role, can obtain educational benefits through interaction with other learners who play other roles. The theories have common characteristics to argue effectiveness of a learning process focusing on a specific role of learners. So, we represent the focus in the theories as **Primary Focus** and **Secondary Focus**.

Primary Focus (P): a learner's role that is mainly focused in the learning theory.

Secondary Focus (S): a learner's role that is weakly focused in the learning theory. The learner who plays this role (S-member) is needed as a companion to enable the learner who plays P-role (P-member) to attain his/her learning goals.

A **W(A)-goal** has two kinds of goals of interaction as follows:

S<=P-goal: a **Y<=I-goal** which means how and for what purpose the P-member interacts with the S-member.

P<=S-goal: a **Y<=I-goal** which means how and for what purpose the S-member interacts with the P-member. In the collaborative learning session, all members of learning group are expected to get some educational benefits. So, the S-member also has an I-goal, and the P<=S-goal should be effective to attain the **I-goal**.

The entities of these goals refer to the concepts defined as **Y<=I-goal**s. The conditions, which are proper to each **W(A)-goal**, can be added to the concepts, if necessary. Each of the **Y<=I-goal**s referred to by **S<=P-goal** and **P<=S-goal** consists of

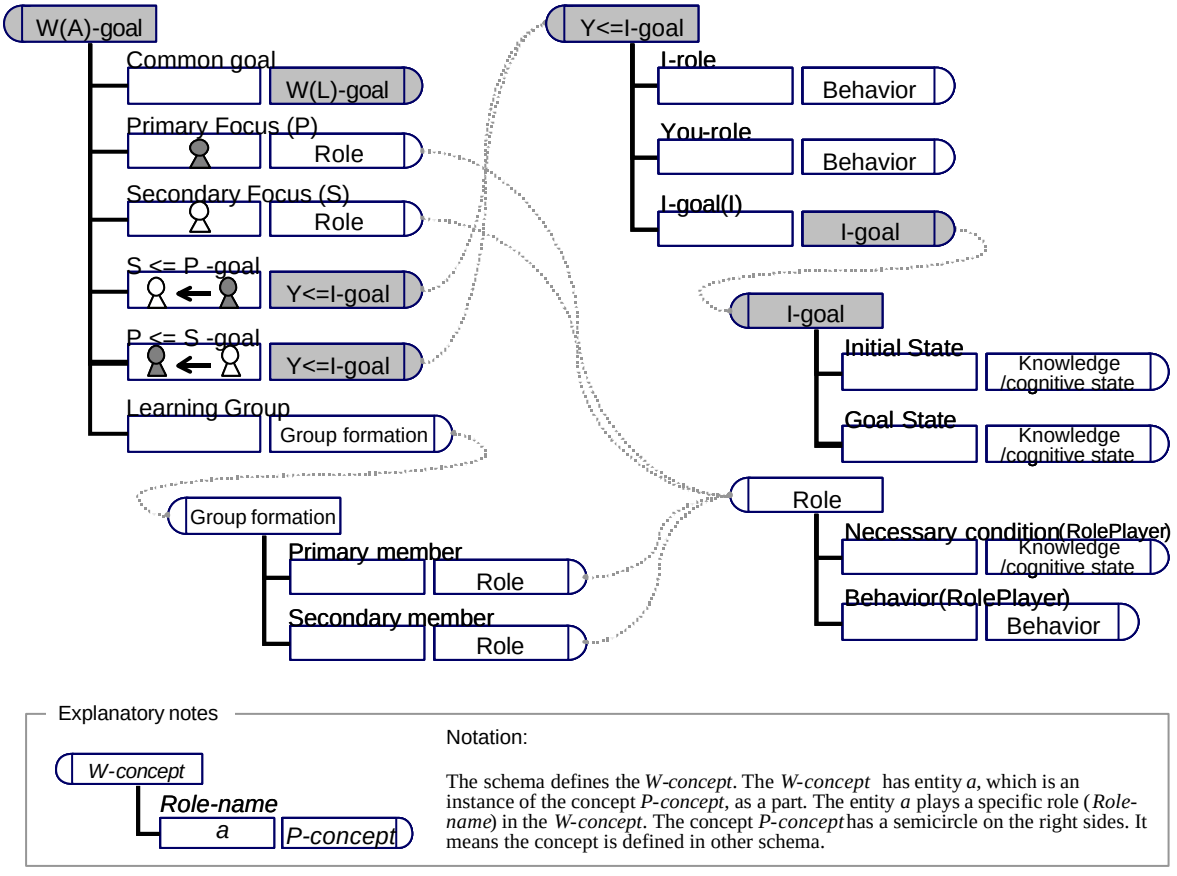

Fig.2 Structure of a W(A)-goal

three concepts as follows:

I-role: a role to attain the **Y<=I-goal**. A member who plays I-role (I-member) is expected to attain his/her **I-goal** by attaining the **Y<=I-goal**.
You-role: a role as a partner for the I-member.
I-goal (I): an **I-goal** that means what the I-member attains.

Each **W(A)-goal** can be expressed by a set of **W(L)-goal**, **Y<=I-goal**s, **I-goal**s, Learners' **Role**s and **Group formation**.

It would be more easily to design a learning session which is effective for learners to attain specific learning goals by preparing the structure to represent the rational arrangement and filling in each component of the structure with suitable concepts according to the theory. Our ontology provides rational arrangements inspired by learning theories and vocabulary to fill in each component. It will facilitate users' shared understandings and reuse a learning scenario of a session [11, 12].

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